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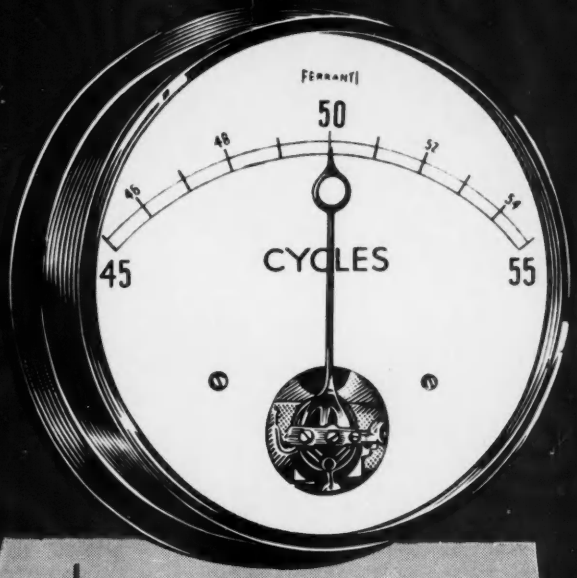
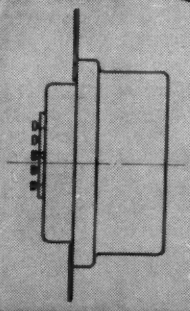


The illustration shows a 6" dial Deflectional Frequency Meter. Shallow pressed steel case. 4", 6" or 8" round or square dial, semi-projecting or flush mounting. Other recently designed Ferranti instruments include, ammeters, voltmeters, power factor meters and dynamometer wattmeters. All types are also available in hermetically sealed cases



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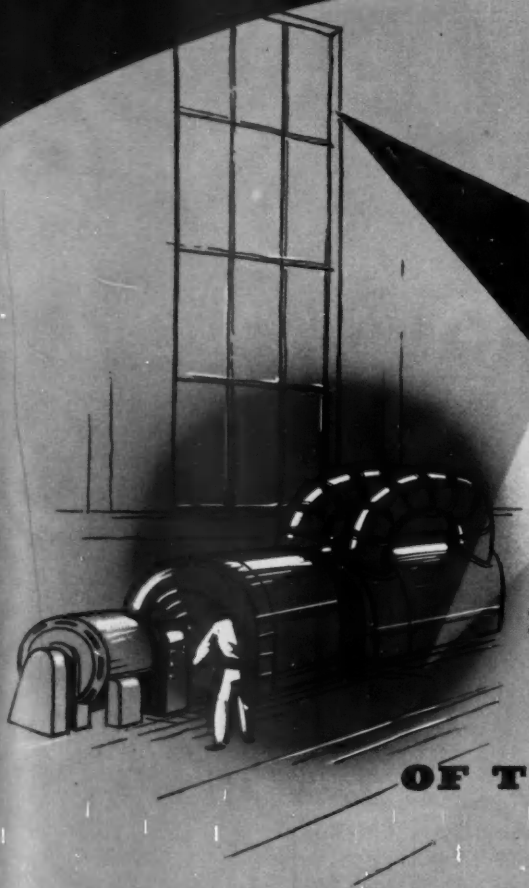

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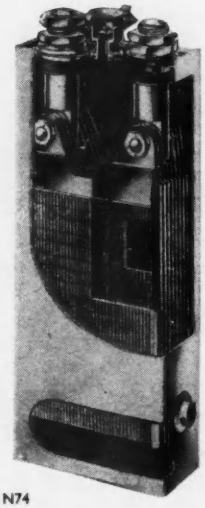

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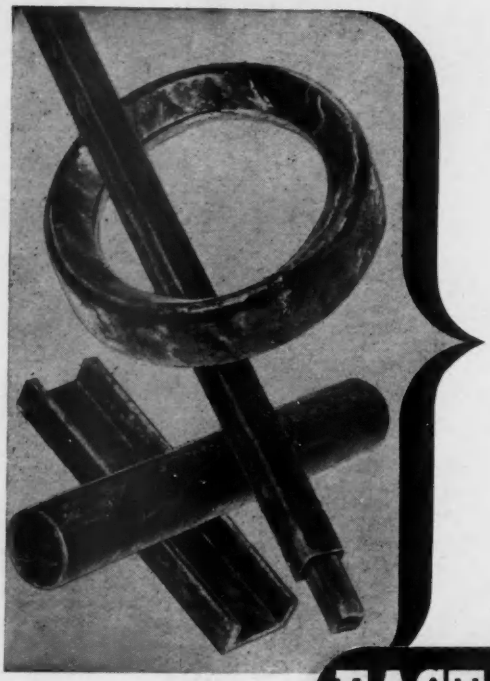

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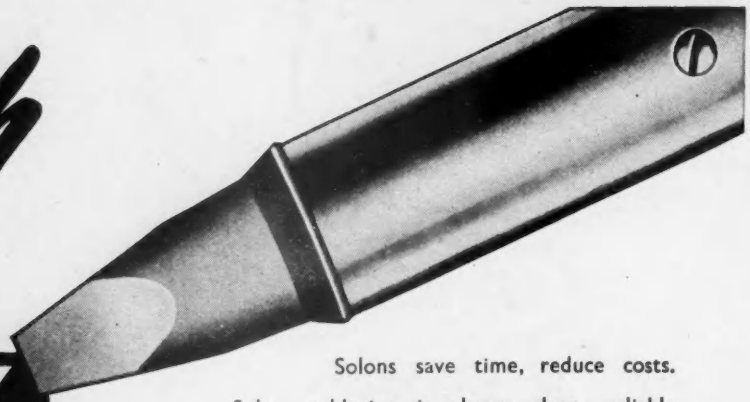

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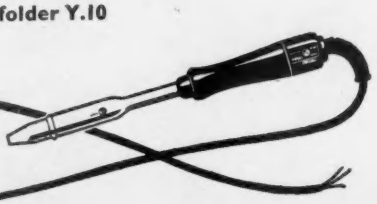

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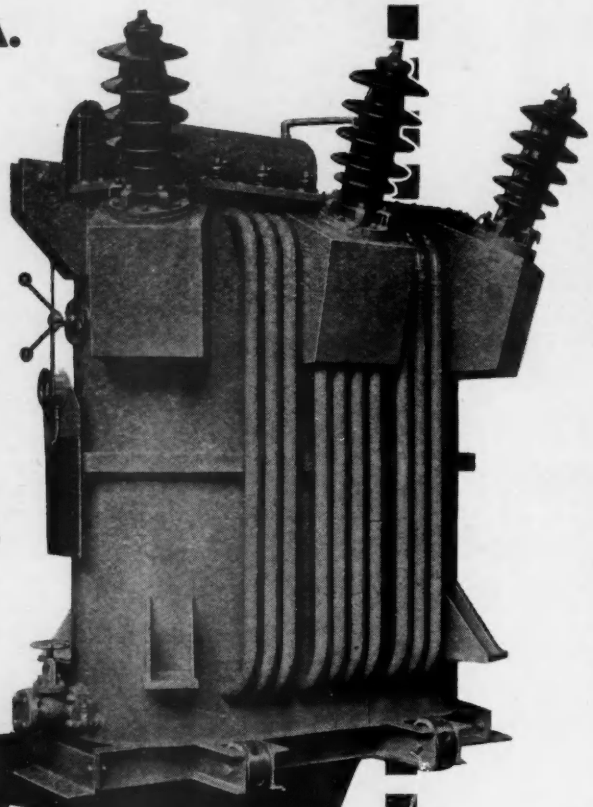

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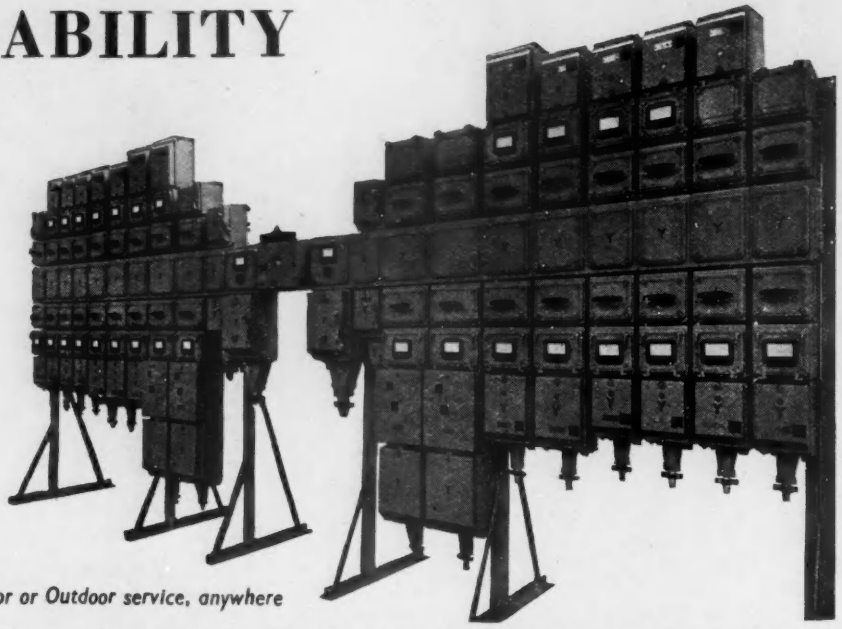

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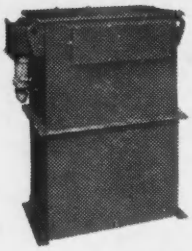

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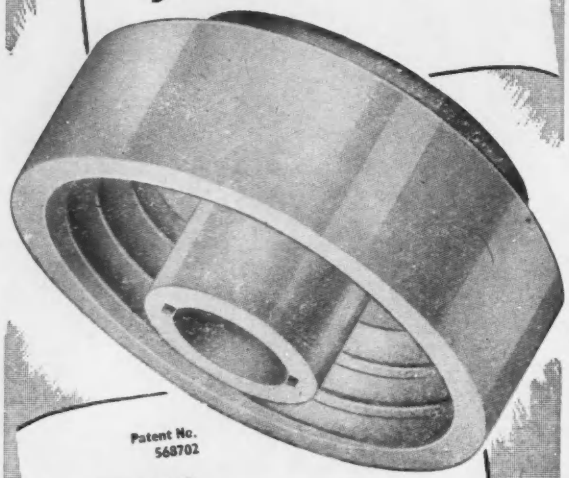

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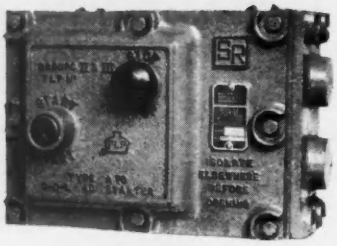

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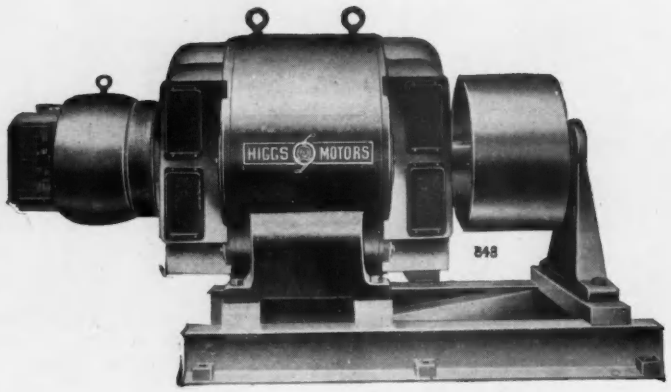

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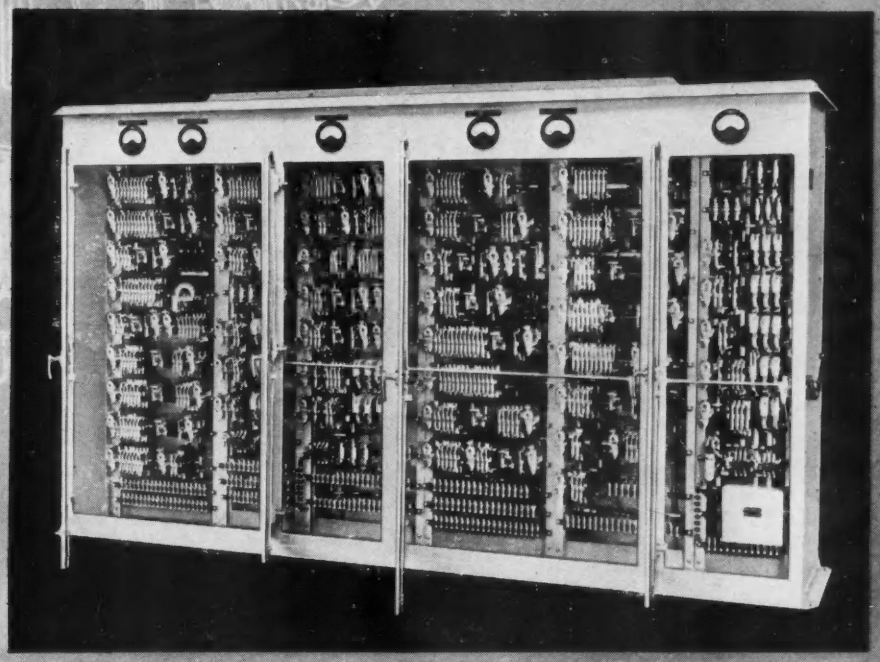

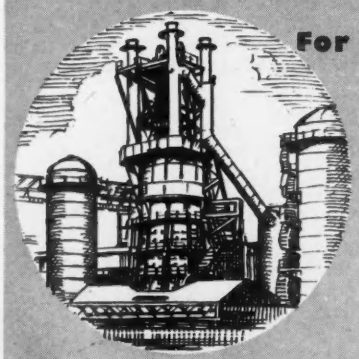

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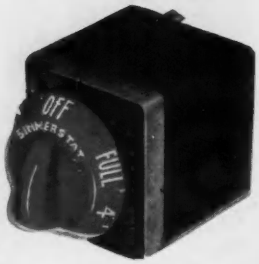

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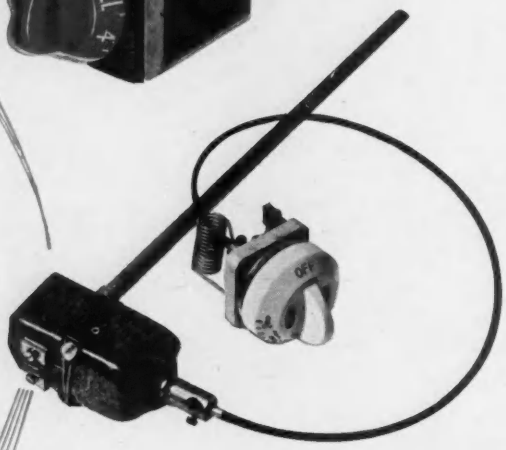

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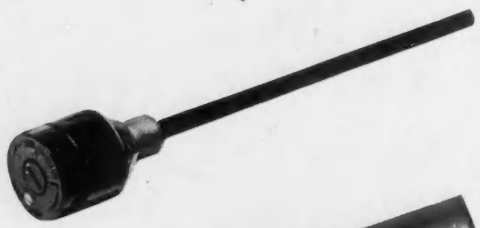

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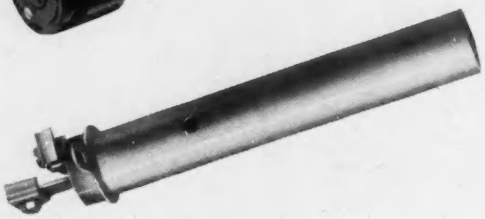

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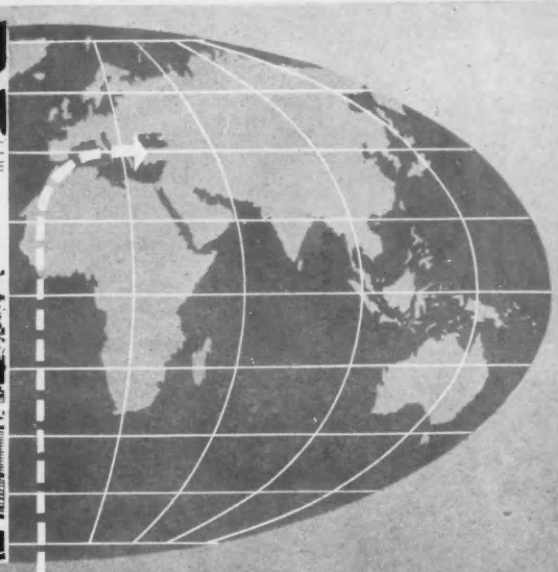

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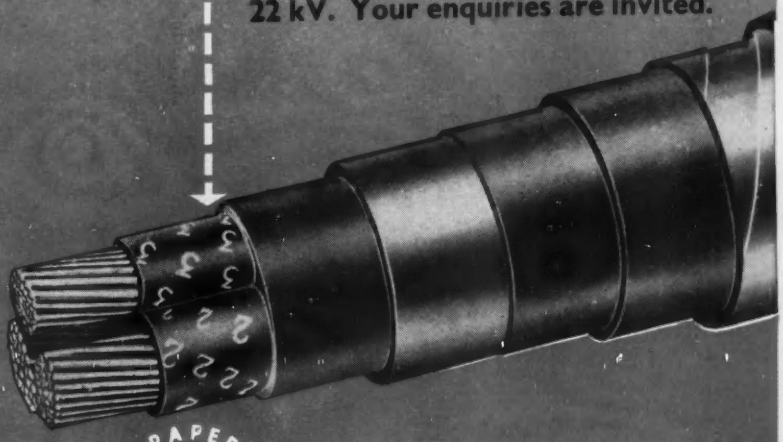

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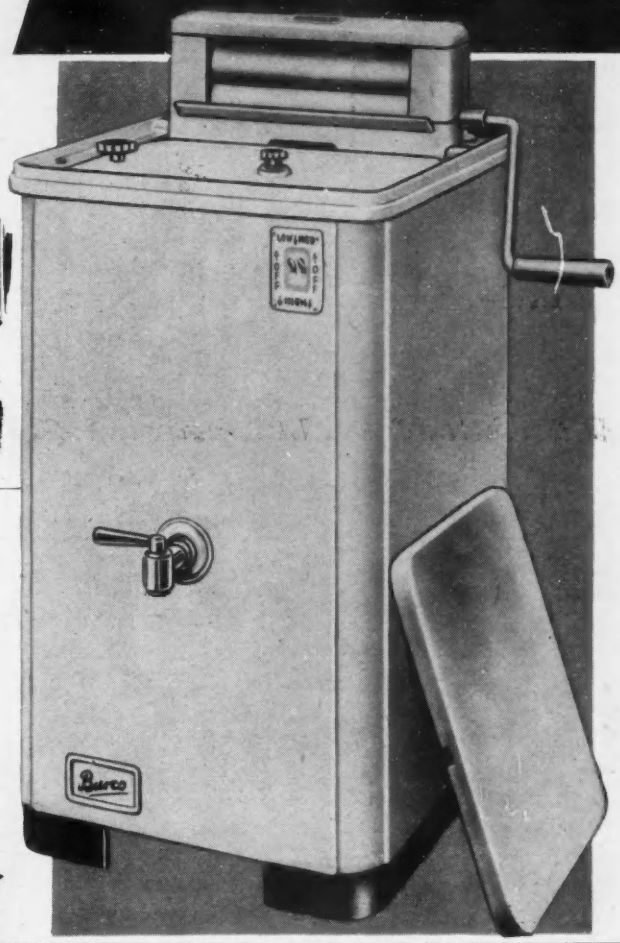

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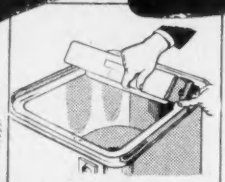

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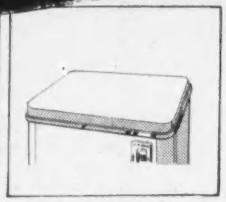
The wringer can be swiftly folded inside the container and the enamelled table top makes a useful addition to kitchen equipment.



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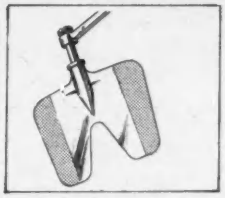

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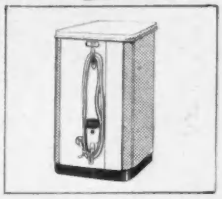

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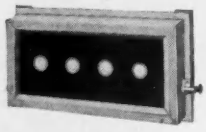

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MERCURY TUBE RELAYS

Other Products include
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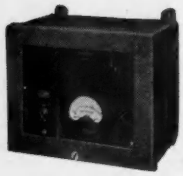

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JULIUS SAX & CO. LTD.
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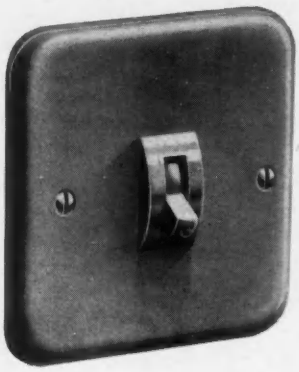
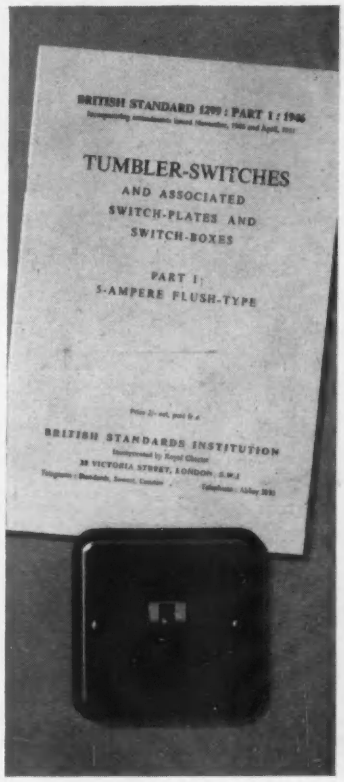
SWITCH TO THE "LINCOLN" TYPE AC

For Replacement Purposes

OBSOLETE surface switches are usually replaced by modern surface switches. However, the current trend places a premium on both exterior appearance and electrical performance. Consequently, where the obsolete switch is on a concealed wiring system, there is a strong case for using the "Lincoln" Type AC flush switch for replacement purposes. Designed with fixing centres of 2⅜in., the switch has a wide range of boxes suitable for all types of wiring. In addition, there are no maintenance costs as the switch gives unfailing service under normal conditions. The "Lincoln" Type AC flush switch thus provides the modern replacement—a high efficiency switch with a neat, elegant appearance.



- The switch may be operated in silence.
- Mechanism cannot be operated by vibration.
- Single- or twin-switch units for erection in one-gang extra-shallow or B.S. 1299 boxes.
- A competitive switch of robust construction, in every way comparable with the other sturdy "Lincoln" wiring accessories.



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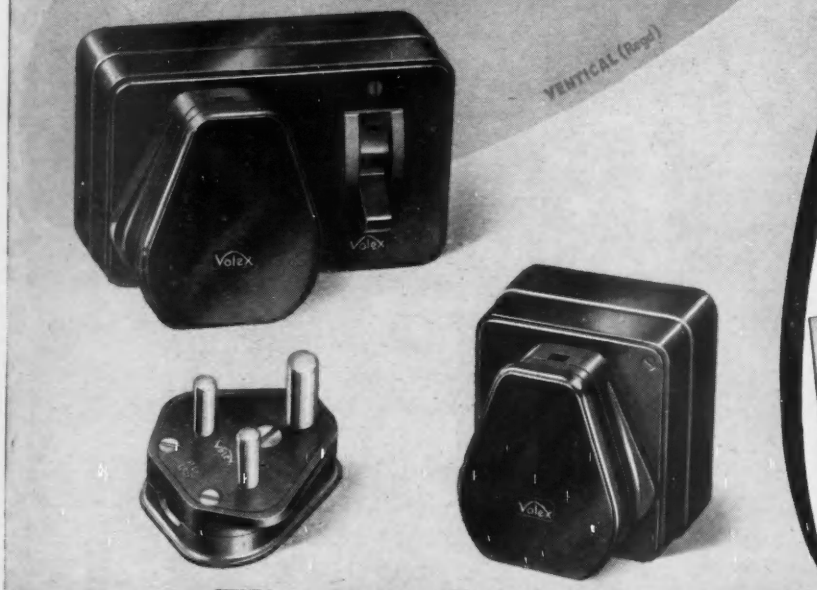
"Crabtree" (Registered)

C.685/237 Advt. of J. A. Crabtree & Co. Ltd., Lincoln Works, Walsall, Staffs.

TO BRITISH STANDARD SPECIFICATIONS 816 AND 546

5 and 15 amp. PLUGS, SOCKETS and SWITCH SOCKETS
5 amp. 1-and 2-Way TUMBLER SWITCHES



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★ SUPERIOR QUALITY

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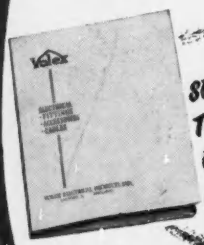
The range of "Volex" 5 and 15 amp. Plug Sockets with and without switch, embodies many features which provide maximum safety and efficiency under the most stringent operational conditions.



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Volex VOLEX ELECTRICAL PRODUCTS LTD
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auto-transformers

The "VARIAC" is the original, continuously adjustable auto-transformer . . . the ideal control for varying the A.C. voltage applied to any electrical, electronic, radar or communications equipment. Voltages from Zero to 17% above line are obtained by a 320-degree rotation of the shaft, which is equipped with a direct-reading dial, calibrated accurately.

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Write for our Catalogue—Technical Manual V-549, which gives all possible information.

Request also our 20-page Supplementary Catalogue giving complete information on our new and complete range of A.C. Automatic Voltage Stabilisers: these range from 200 VA to 25 kVA. Performance is excellent, from No-Load to Full Load, and stability is quite unaffected by frequency variations.

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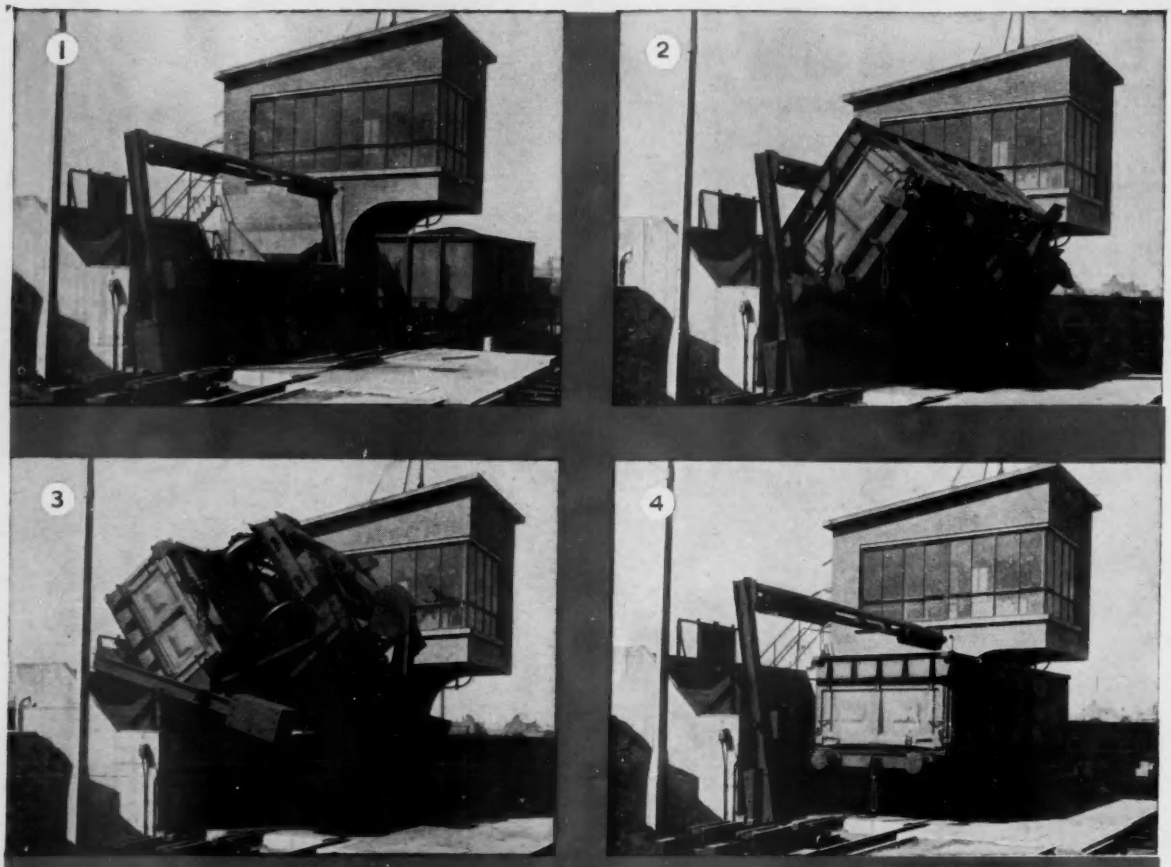

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The side-discharge tippler was first introduced by Mitchells and machines of this type are still unequalled in design and efficiency. They can handle all sizes, conditions, and types of wagon without adjustment of any kind, and at a greater speed than any other design.

The load is discharged to the side of the track, clear of loading gauge, so that the coal can be grabbed or handled in any way without interfering with normal rail traffic. Side-discharge tipplers can deal with wagons up to 65 tons net load and smaller wagons can be unloaded at rates of up to 60 wagons an hour.

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Mitchells have been installing tipplers for more than 30 years at power stations, steel works, collieries—in fact anywhere where large loads of raw materials or fuel have to be handled quickly. Mitchells also specialize in wagon tippler hoists and locomotive coaling plant.

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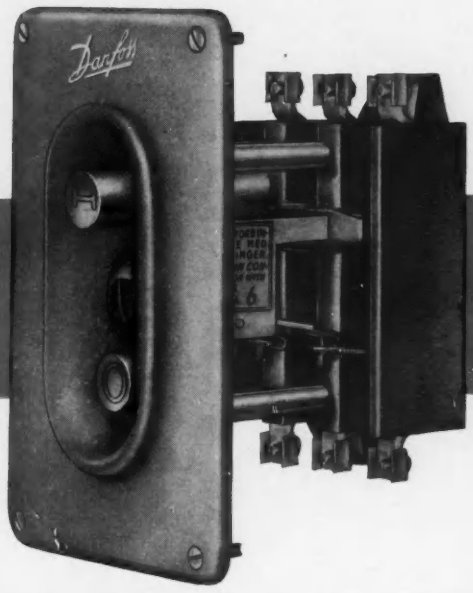
GENERAL-PURPOSE
MILD STEEL
WALL-MOUNTING

Here are our reasons for recommending this starter:



Vibration-resistant snap-action switch mechanism
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Seven relays cover the range from 0.2 to 15 amps.
Double-break silver contacts
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FLUSH-MOUNTING

Please write for leaflet Z 33-140 which gives detailed information

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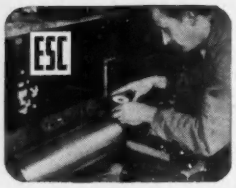
Smiths Hand Tachometers are amongst the most versatile instruments ever made available to industry. They indicate rotational speeds or surface speeds, indicate any fluctuation of speed and any particular reading can be observed simply by pressing a button before disengaging from the point of drive. The illustration shows a Smiths Hand Tachometer in use in the Cutting Tool Development Department of the English Steel Corporation Ltd., Openshaw, Manchester. In this instance the instrument is indicating surface speed of a test bar during a turning tool investigation. May we send you Leaflet ET containing full particulars of this most valuable range of instruments?



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MICA UNDERCUTTERS

Mica Undercutting by the use of files (and "sweat") has always been regarded as a method productive of satisfactory results.
The Universal Motor driven
"JIFF-V"
Undercutter gives a similar clean "V" or "U" slot in a "jiffy", and eliminates the hard and tedious work.

"U" as well as "V" cutters now available.

The high-speed file is easy to guide and permits cutting clear up to the commutator risers.
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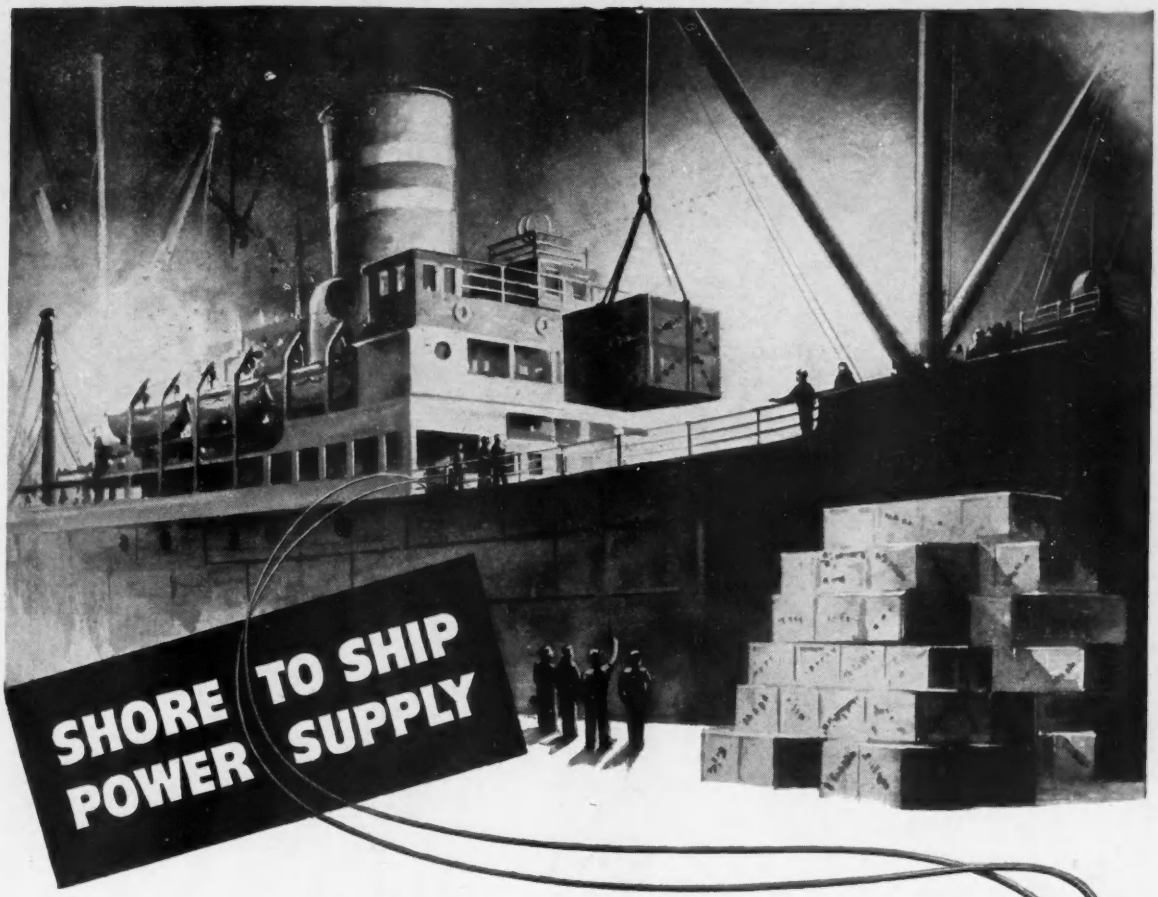

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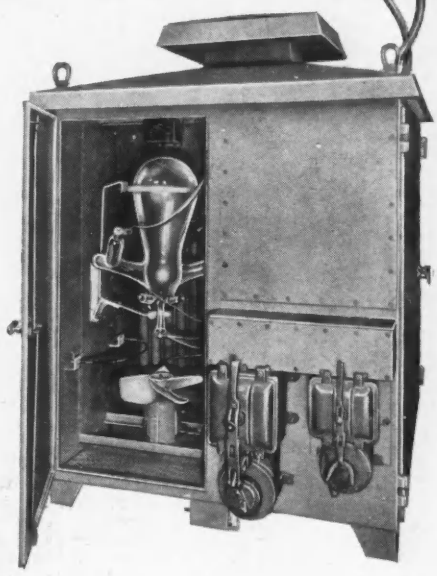

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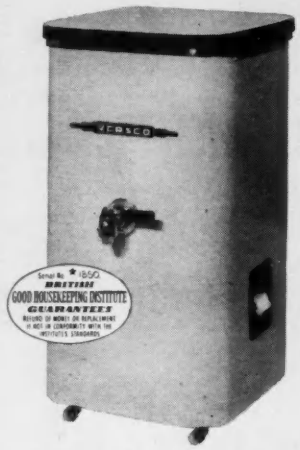
VERSCO

wash boilers new editions of a famous range



VERSCO SQUARE BOILER

VERSCO ROUND BOILER

VERSCO SQUARE DE LUXE BOILER. This smart and compact boiler is fitted with castors for easy movement and is finished in cream stove enamel. The table-top in cream vitreous is an attractive feature.

VERSCO ROUND BOILER. Obtainable in Galvanised finish as shown (a most durable finish of special appeal for Corporation and other housing schemes) or in cream stove enamel.

THESE FEATURES ARE COMMON TO ALL VERSCO MODELS: Heavily tinned 10 GALLON copper container —Double pole 3 heat rotary switches A.C. or D.C. (safety cut-out available if required)—Chromium plated taps with heat-resisting handles—Six 500 W clamp-on elements give maximum loading of 3 Kw.—Top surrounds in die-cast aluminium and pressed aluminium loose lids for easy access.

Send for new leaflet giving full specifications and prices.

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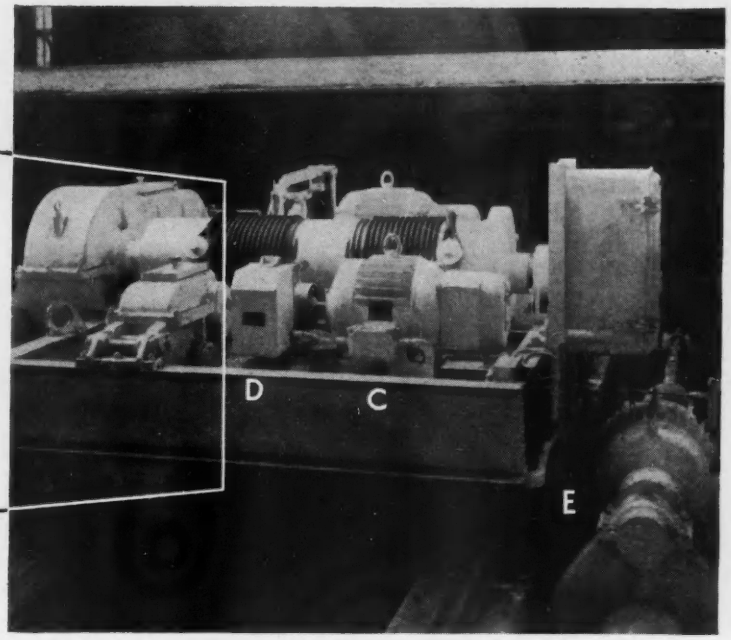
WASHING MACHINES

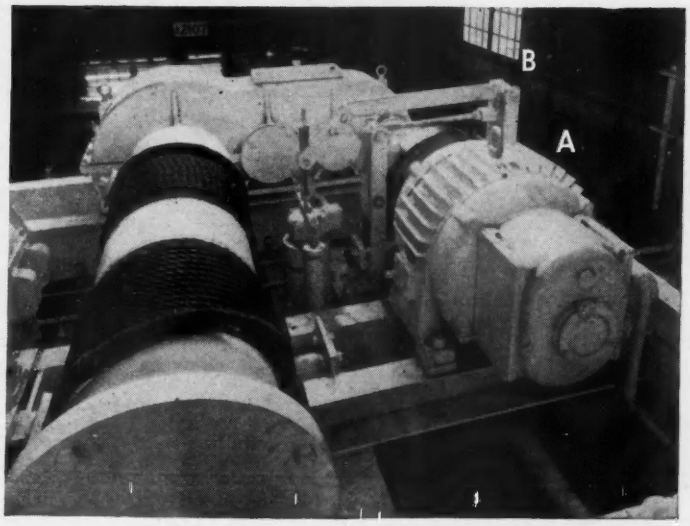
500H MODEL heats the water, 6 lb. dry weight capacity, 12" wringer which folds down when not in use. Exclusive Swirlux agitator. (Unheated version 500 MODEL also available.) 503 MODEL—10/11 lb. dry weight capacity, full size power wringer with five working positions. Exclusive Swirlux agitator. Power pump and hose for quick emptying. For full details send for Swirlux Leaflets.

Universal Boilers & Engineering Co. Ltd., Fulledge Works, Burnley, Lancs.
TELEPHONE: 3121 and 3203

ON TOP OF THE JOB



Metrovick equipment is well on top in this 10-ton Wharton overhead shop crane. The hoist is an 18-h.p. 720 r.p.m. M-V motor fitted with a thrustor-operated brake giving precise control with stable creeping speed on load. The need for inching is thus eliminated. Drives for the long travel and cross-traverse are M-V 10-h.p. 715 r.p.m. and 3-h.p. 700 r.p.m. type MZ slipring motors respectively. A 6-inch Perigrip brake operates on the cross traverse. Write for details of the range of M-V a.c. and d.c. motors, control gear and Perigrip electromagnetic brakes for crane drives.



In the illustration (left) A is the 18-h.p. 720 r.p.m. hoist motor fitted with Stacreep thrustor control B. The long-travel drive, motor E, is shown at the top of page. The 3 h.p. cross traverse motor is seen at C and the 6-inch Perigrip brake at D.

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

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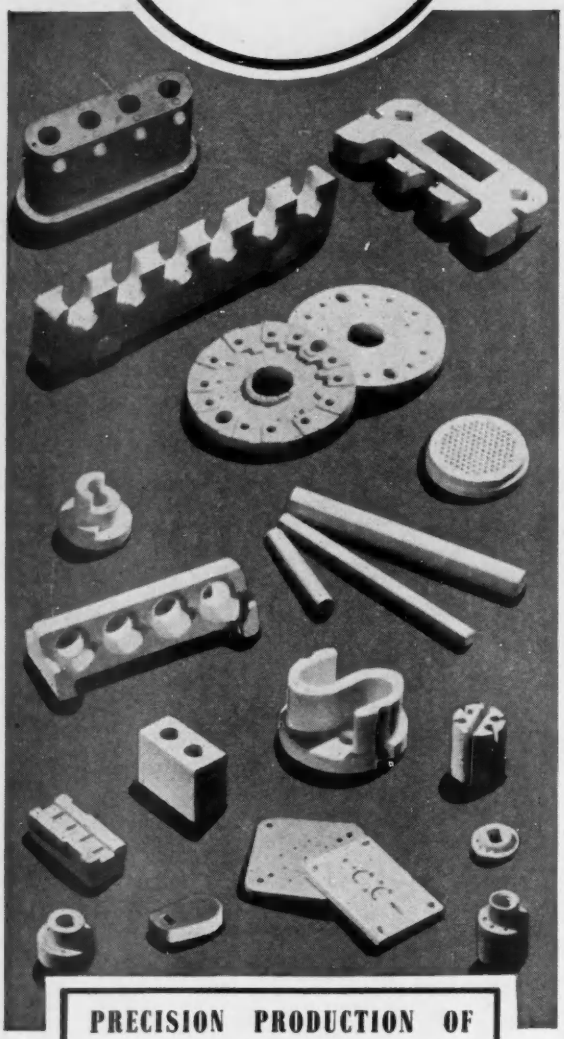

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The ½ h.p. 'ENGLISH ELECTRIC' Magamp will give you push-button control in forward or reverse and flexible speed variation over an 8 : 1 speed range for a thousand and one tasks.

Except for the forward and reverse relays, there are no moving parts and no valves, consequently maintenance is practically unnecessary.

Typical applications for 'Magamp' motor control drives are:— power sewing machines, bobbin winders, work handling jigs, small lathes and potters' wheels.

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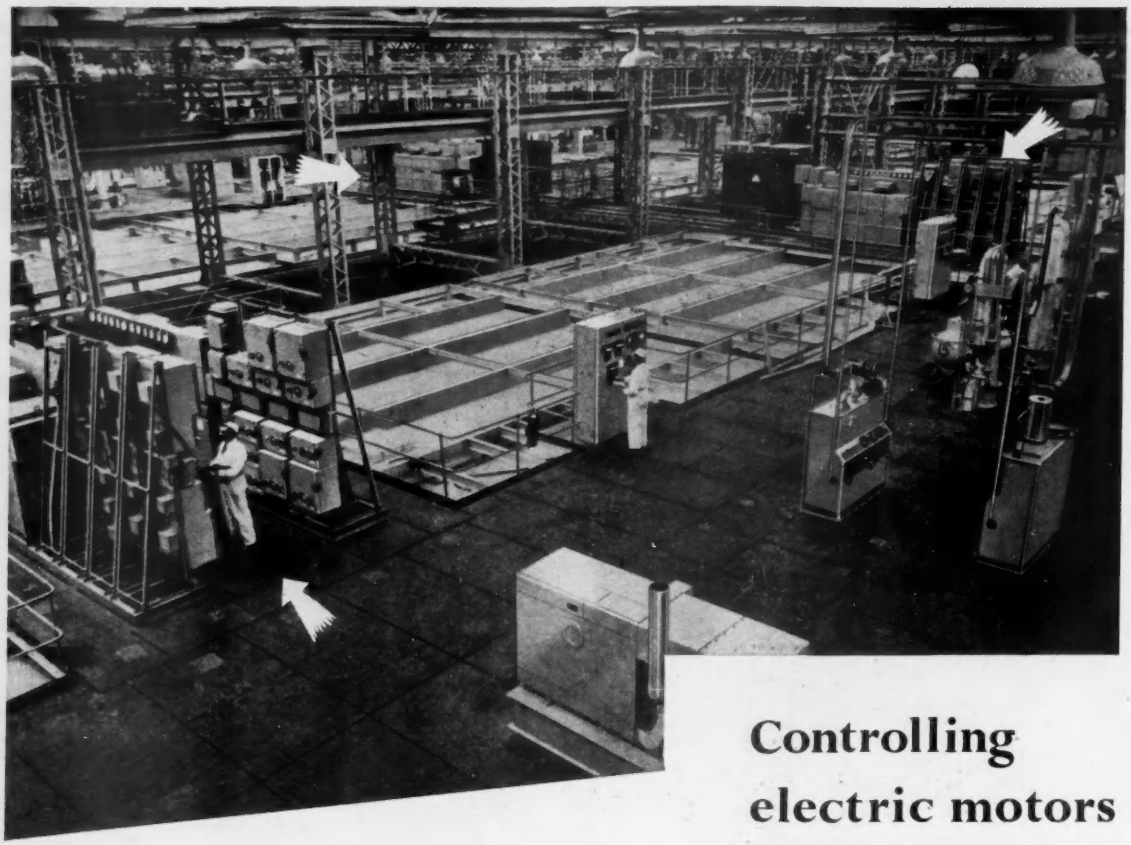
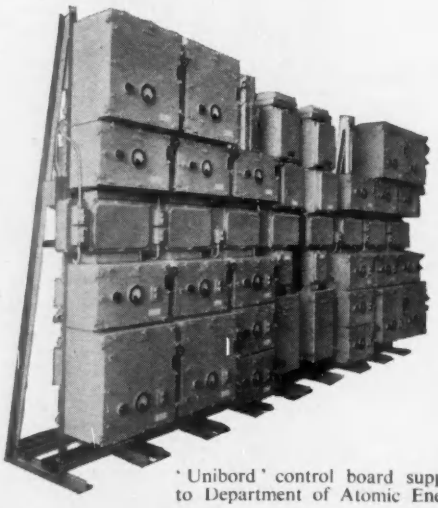


Controlling electric motors at Capenhurst Atomic Energy Factory

To the order of the Department of Atomic Energy, Industrial Group Headquarters, Brookhirst Switchgear Ltd. in association with A. Reyrolle & Co. Ltd. have supplied a very large number of motor control switchboards for installation at Capenhurst Works where Uranium 235 is processed by a gaseous diffusion plant. Part of the equipment is shown in the above illustration of one of the control decks.

Some of the switchboards are of ' Unibord ' type of construction which is eminently suitable for applications requiring a rugged, dustproof construction and a high degree of flexibility. Built up of standard interchangeable units, this type of construction lends itself to rapid adaptation and extension. It has been an outstanding success in Gasworks, Power Stations, Iron and Steel Works, Collieries and Chemical Works, where robust construction combined with adaptability for sequence control and easy extension or modification solve many of the Engineer's problems.



' Unibord ' control board supplied to Department of Atomic Energy.

BROOKHIRST MOTOR CONTROL GEAR

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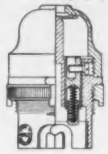
Ashley Regd. B.C. LAMPHOLDERS

Eight types of "Ashley" B.C. Lampholders, listed in one hundred and thirty-two variations. All are well designed, precision made from the best materials, and quality controlled. Each one is "Ashley" branded, guaranteed, and reasonably priced.

FEATURES. Moulded, or with porcelain interiors. Brown or white. Brass liners. Spring or solid plungers, with non-rust springs. Easily wired terminals. Lug grip shade carrier rings with brown holders. White holders have short shields. Home Office pattern ventilated shields. Excellent finish. Complying B.S. 52.

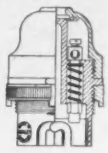
SPRING PLUNGERS

Terminals stationary during lamp insertion or removal.



SOLID PLUNGERS

Terminals move during lamp insertion or removal.



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Spring or solid plungers. Has effective cord grip. One type lamplocking, key operated.

CORD GRIP 'DREADNOUGHT'

Heavyweight, with porcelain interior, solid plungers, non-rotating cap, and effective cord grip.

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Spring or solid plungers. Choice of six threads:—
⅜", ½", ⅝" brass,
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T.R.S. GLAND

Spring or solid plungers. With screwed bush and grommet, to grip 14/.0076 round twin T.R.S.

BATTEN

Spring plungers. Easily wired body removes from base rear. 2" fixing centres. Available with "loop-in" third terminal.

SIGN

Spring or solid plungers. With shade carrier ring Without cap. For clamping through a metal or other plate.

"Ashley" Home Office pattern shield

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Angled 45°. Spring plungers. Easily wired body removes from base rear. 2" fixing centres. Available with "loop-in" third terminal.

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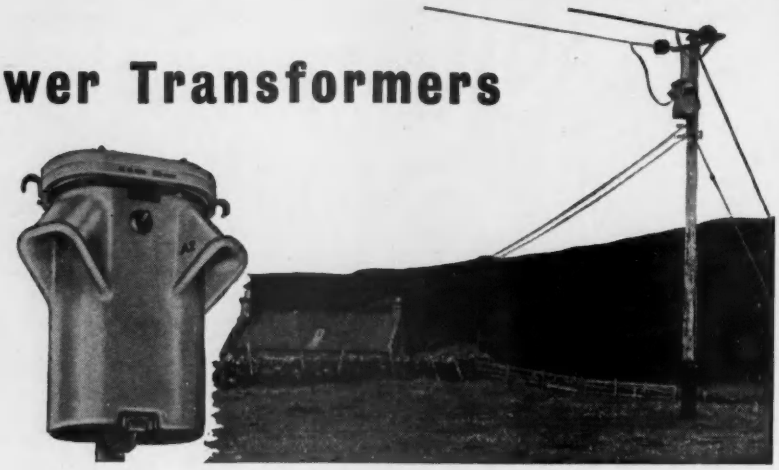

Photograph by courtesy of British Insulated Callender's Construction Co. Ltd. and the North of Scotland Hydro-Electric Board.

- No maintenance costs. Containers are salt and acid proof. Supporting steel work is heavily galvanised. Hermetically sealed container protects oil from acidity.
- Increased efficiency and reduced operating costs due to low losses.
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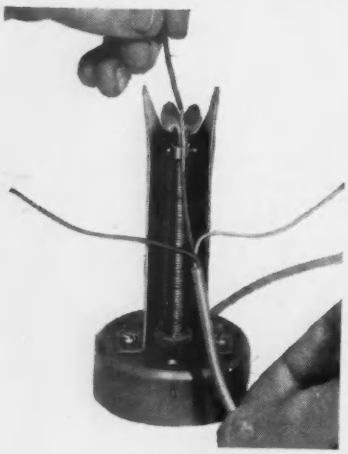

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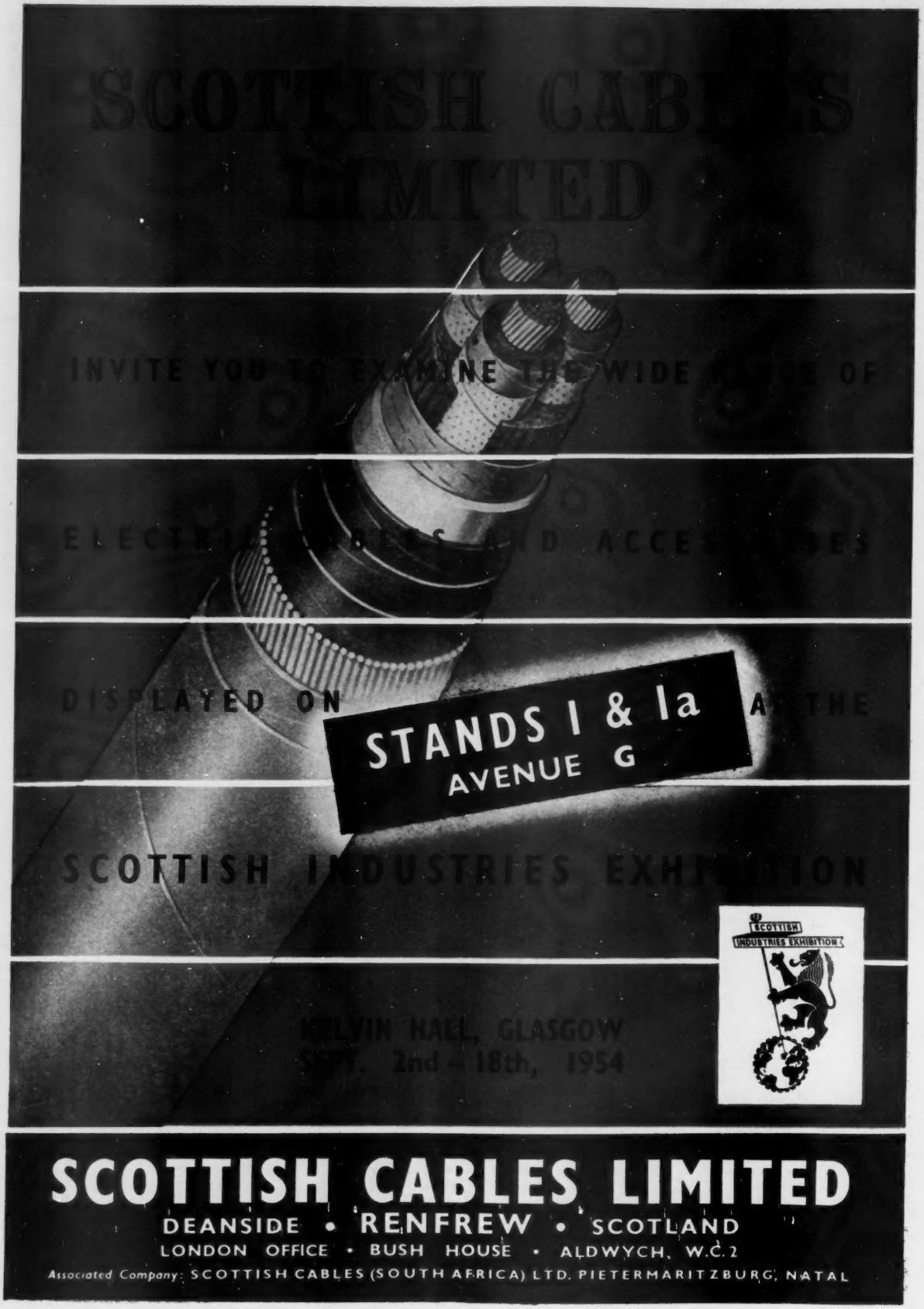

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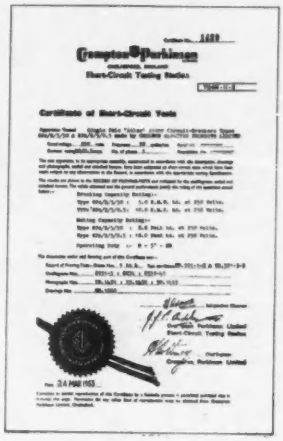
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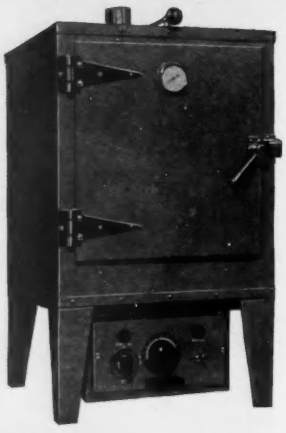

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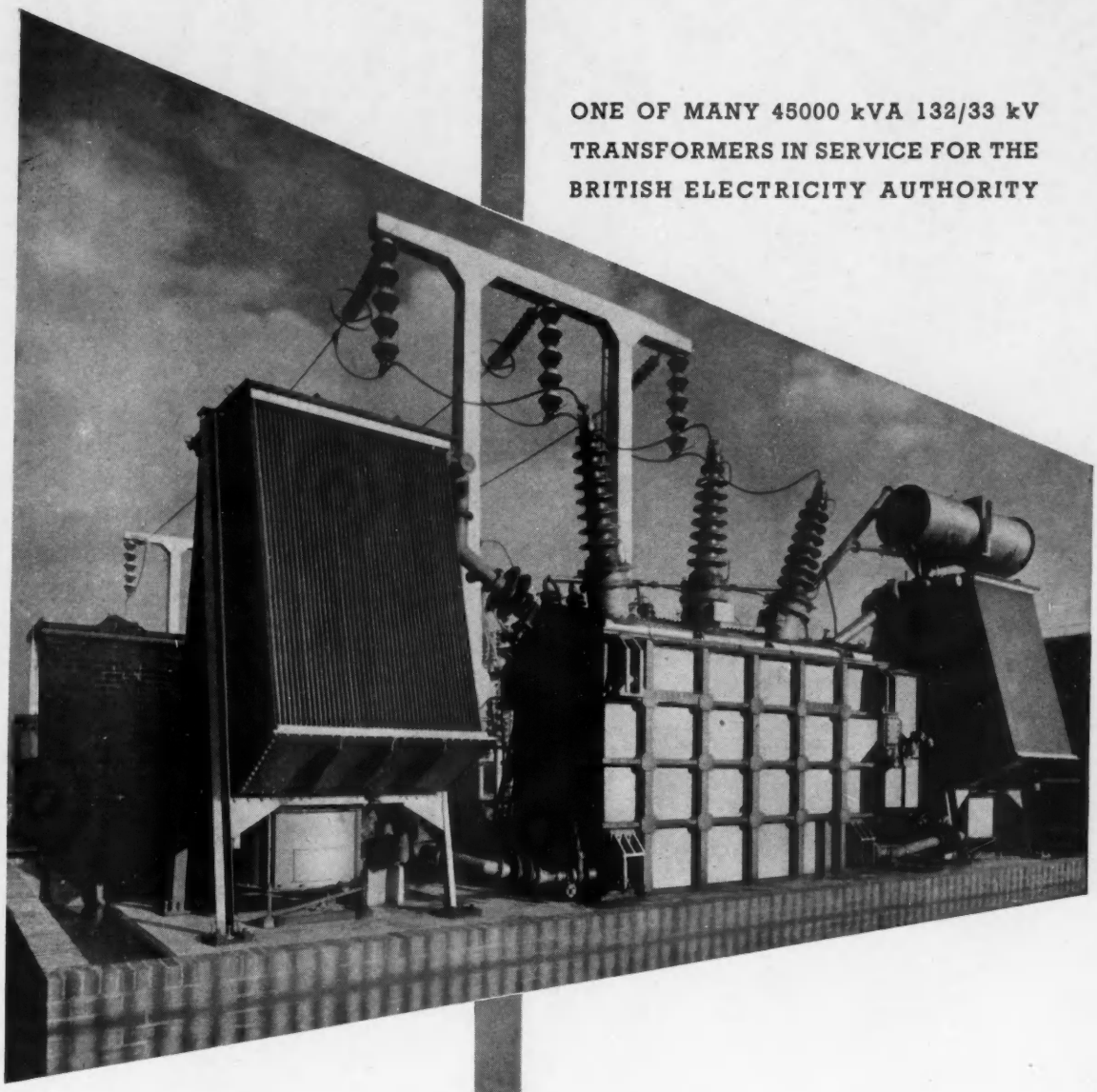

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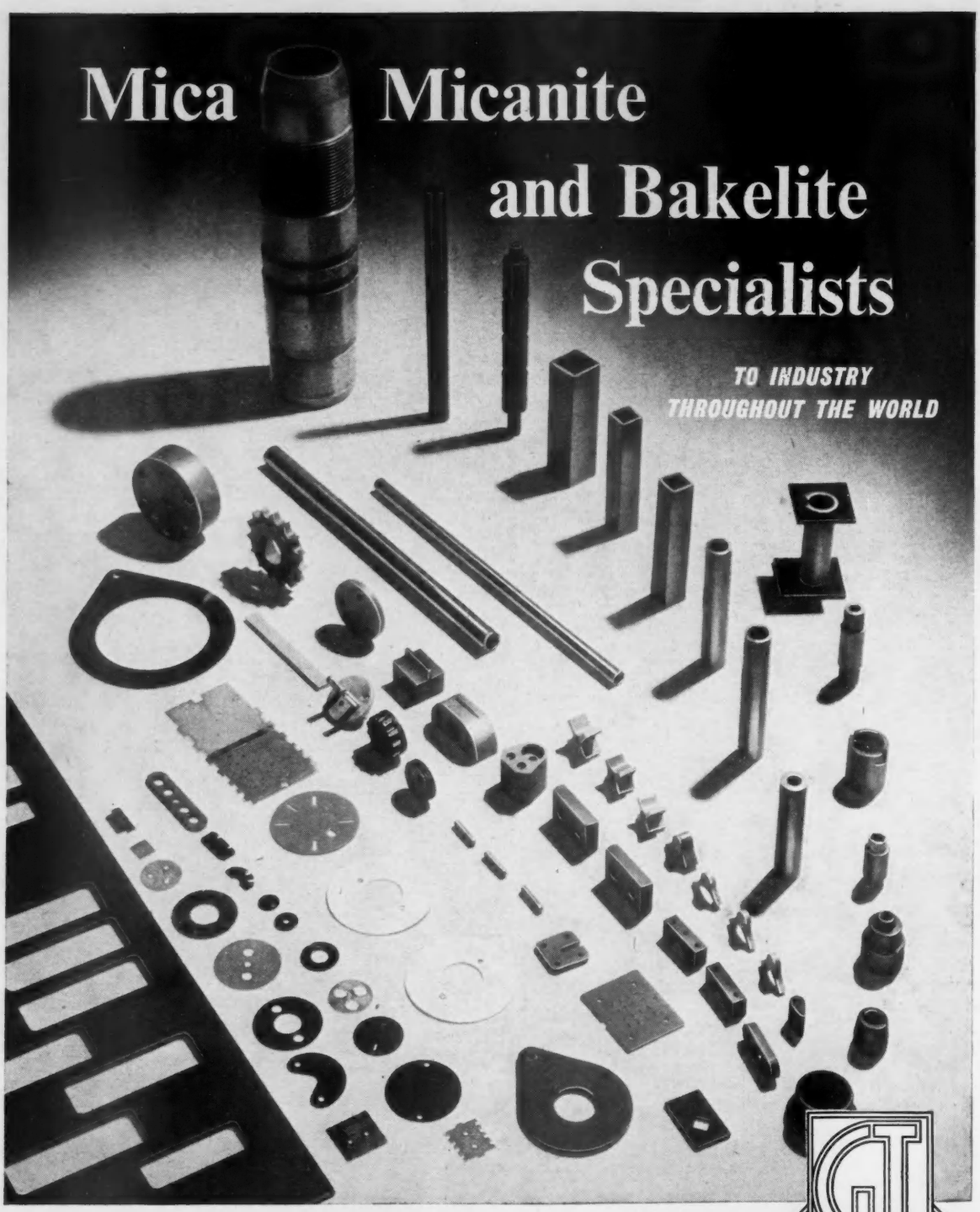

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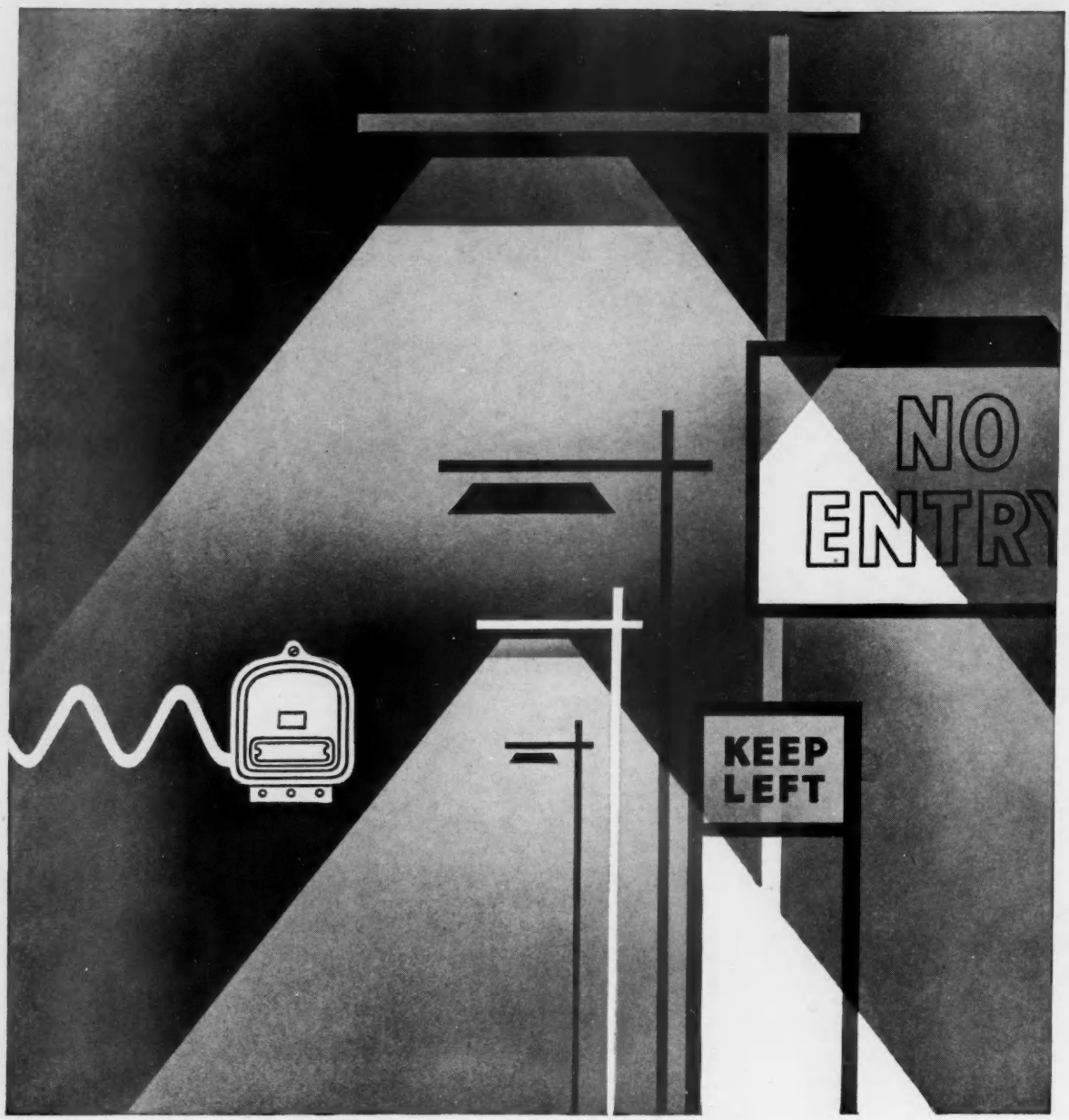

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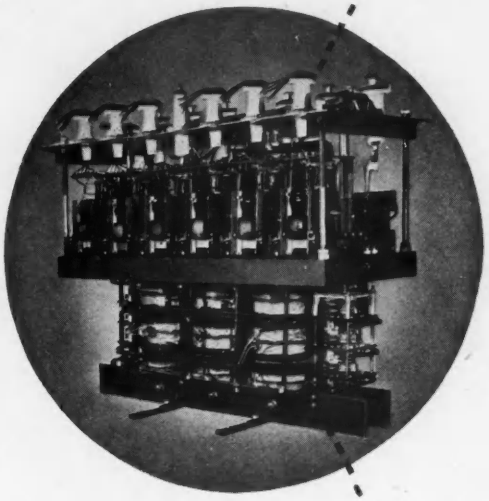

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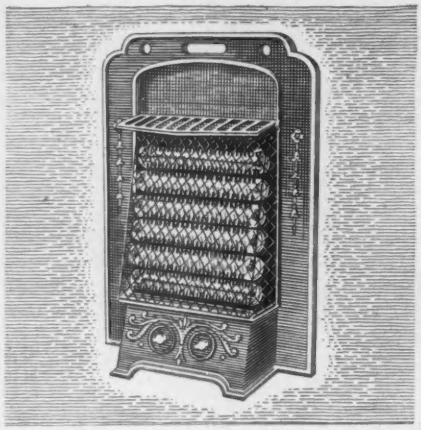

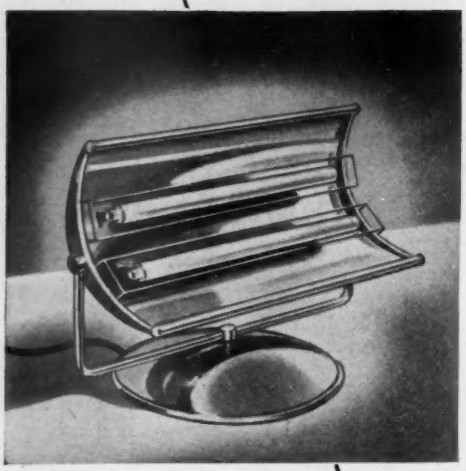

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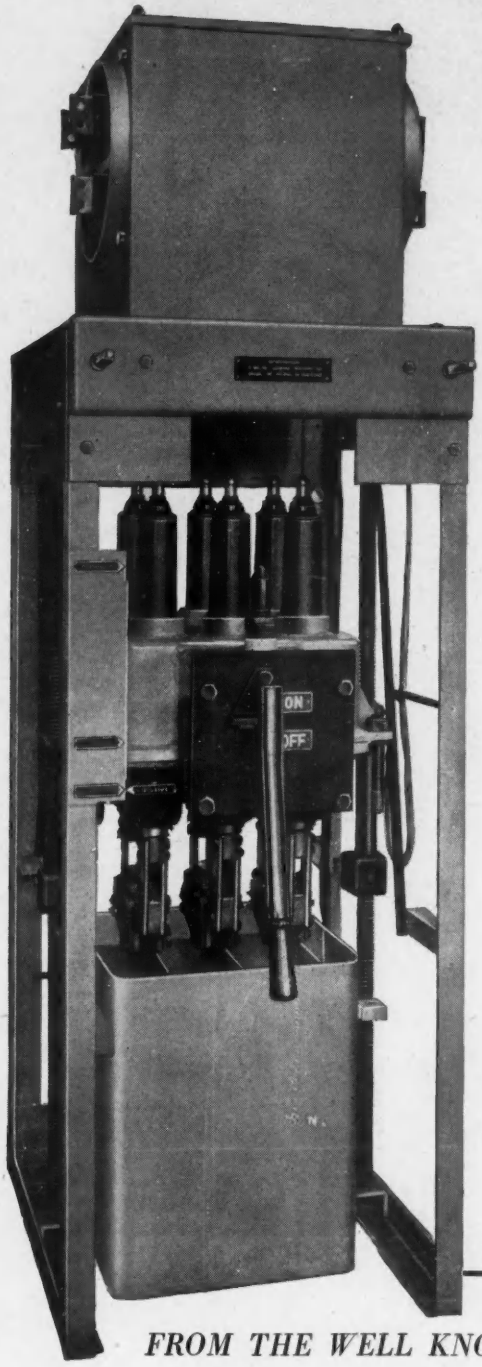

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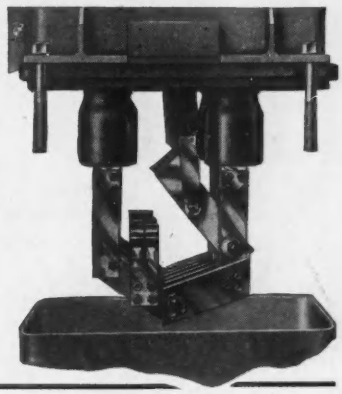

★ Internal view of a unit showing contact arrangement

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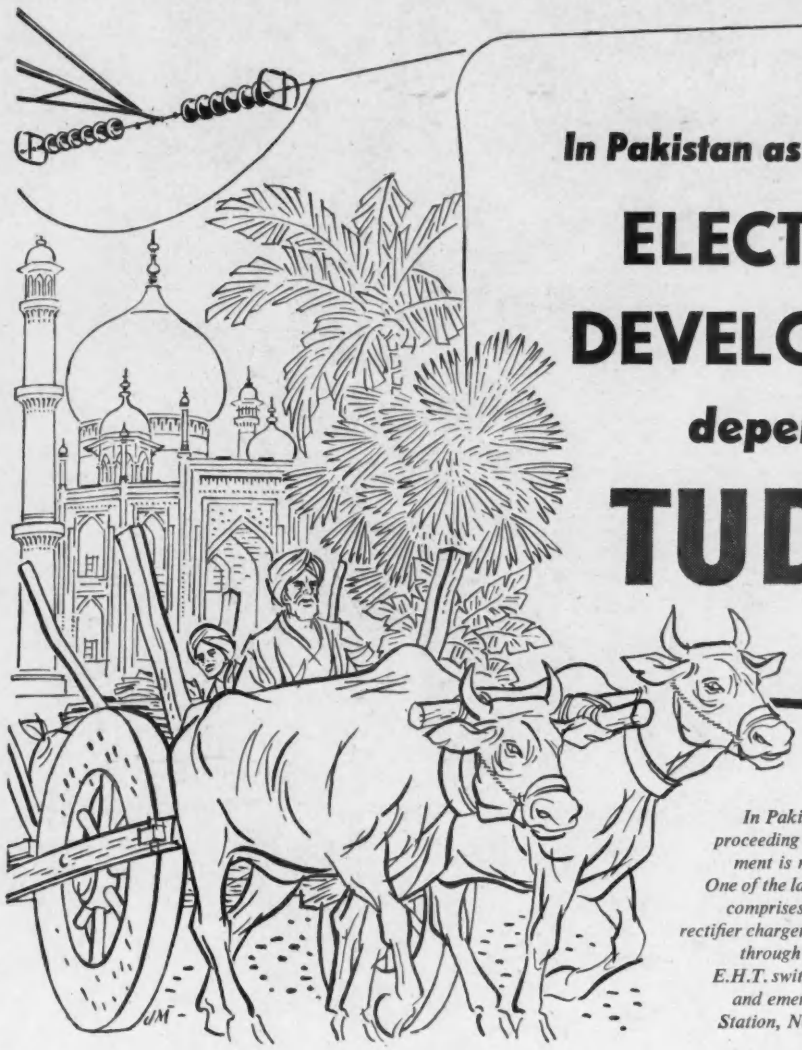

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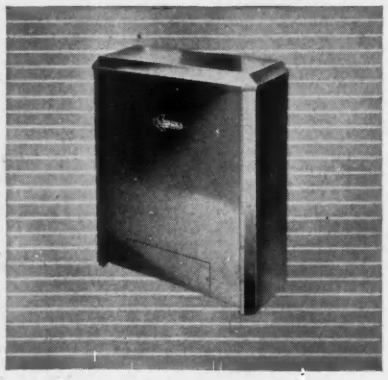

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ELECTRICAL TIMES

ESTABLISHED 1891

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SEARCHLIGHT ON THE B.E.A.

The announcement last week in the debate on the Borrowing Powers Bill of the setting up of a committee of enquiry into the organisation and efficiency of the electrical supply industry comes as a sharp surprise, for although some such seven-year investigation was promised in 1948 by the Labour Government, the present time seems hardly opportune. To institute an enquiry into the organisation of the industry immediately after the Government has committed itself to the severance of the Scottish boards, suggests a vacillating policy uncommonly like bolting the stable door after half the horse has been turned loose. However, the wisdom of this particular step is not a matter with which the committee is likely to concern itself; there remain other major questions of organisational structure, at present limited by statute, that deserve public ventilation and such an enquiry is a necessary prelude to any changes. At a lower level also a general overhaul should do little harm and will certainly dispel some of the suspicions that are current regarding the B.E.A.'s own study of its organisational problems. Much will depend on the policy of the committee in taking evidence, for this will be more than a weighing of submissions by representative parties, but an enquiry into a nationalised body with all the inhibitions of executive staff that that implies. It may well be that the committee will find it necessary to initiate their own lines of investigation. In this, the absence of any member qualified to speak from an intimate knowledge of the industry must surely provide a serious handicap, particularly as it will strike at any confidence of the supply industry in the committee's deliberations. There are such men of adequate status and experience available and since the Ministry has failed to make use of their services, it is to be hoped that the committee itself will repair the omission in some measure by the appointment of suitable assessors.

WINTER CRITICISM AHEAD?

Coal has become a topical problem once more; the statements at the annual conference of the National Union of Mineworkers, taken together with the Government's decision to import coal again this year has brought into the public view the difficulties that are likely to face the country this winter. The position was reviewed on these pages in May, and since then the main change has been a sharpening of the outlines of the threatening picture then apparent. However, it seems improbable that anything like 1947 is in store for the electricity industry, though the inclement weather of recent months has

brought reminders of the summer preceding that disaster. The danger to electricity this winter is not that power station stocks will fall to a level where a prolonged cold spell can endanger generation, but rather that the general difficulty of coal supply will lead to agitation for restrictions on the use of electricity, based on the half-truths and mis-statements that are so familiar. Restrictions will be unnecessary this winter, and the industry must be prepared to convince the public of this. It is vitally important that there should be no setback at this moment in the industry's recovery from the lean years, now that it is once more sweeping ahead in the public confidence. The answer may lie in emphasising during the next few months the unsuitability of power station coal for other uses. Though even this coal may eventually be in short supply, as the debate in the House of Commons showed, oil will come to hold the fort until the full development of nuclear power banishes the coal problem for ever from the electrical field.

FOR THE PRACTICAL SCHOLAR

The present General Certificate of Education has inherited from its predecessors, the General and Higher School Certificates, a marked academic flavour. Youngsters who have a more practical bent inevitably suffer in some degree, and it is because it provides for them that a new version of the General Certificate, announced last week, is worthy of close attention. A new examining body, set up by technical institutions and associations, will administer the new Certificate, which will meet the special needs of students taking technical and commercial courses in secondary schools and evening colleges. It is in the treatment of well-established subjects at G.C.E. level, such as mathematics and science, that the difference between the new examination and its time-honoured equivalents is likely to be seen most significantly, though there will be some hitherto unavailable subjects introduced. There can be no doubt that the traditional broadly based academic course has many qualities, but there are obvious advantages in the alternative which this examination suggests, designed, in the words of the official announcement, "to provide a general educational qualification for university entrance purposes without undue and uneconomical disturbance to the main course of professional studies." Further, there is the possibility that at ordinary level the new certificate may provide a much needed common test for entry to National Certificate Courses. Much will inevitably depend on the standard at which the questions are set and marked. With successful judgment here, the Associated Examining Board Certificate may become of first importance in engineering education.

GAS TURBINES READY FOR COAL

The prominence given to work on the coal burning gas turbine in the latest report of the D.S.I.R. Fuel Research section draws attention to the vigour with which the research stations are pursuing their part in the drive to keep this country in the lead in all aspects of gas turbine technology. There is evidence in the report that a considerable degree of success is being achieved in the work on combustion chambers for coal, which is the particular concern of the Fuel Research Station in this field. The many problems relating to the ash content of the coal to be burnt are being resolved, with a solution emerging along two main lines: combustion of powdered fuel with minimum deposition of ash in the combustion chamber, and the direct burning of high ash content coal fires under slagging conditions. With the latter type of furnace experiments have been extended to coals having an ash content as high as 28%. So far the work has been essentially of a research character, carried out for convenience at atmospheric pressure rather than under the pressurised conditions which will apply in an open cycle gas turbine. Now it is moving forward into this practical field, a corresponding quickening of the tempo may be expected. There are many problems still to be solved, but the practicability of the coal burning gas turbine is steadily advancing. When it is achieved it will bring many alterations in the estimates of electrical possibilities which we have been accustomed to making on the assumption that coal can only be usefully burnt in boilers.

COMPUTORS FOR DESIGN

Amongst the many subjects discussed at the Industrial Electronics Convention last week, it was electronic computation which showed the most significant advance. The work of exploring the mathematical possibilities of some of the machines that have been built is now over: success in solving practical problems economically is to be the criterion of their worth in the future. To a considerable extent such success is dependent on salesmanship. As one author pointed out, the electronic digital computor is too often called in as a last resort, whereas its greatest value can be extracted only if it is considered at the very beginning of an engineering problem, and subsequent mathematical work is planned on the assumption of its use. With the computor developed to this stage, it seems that a knowledge of its potentialities will before long be considered part of every senior design engineer's education.

MORE NOISE FOR ELECTRICITY

The Royal Show this year was principally distinguished by its size, for it is the largest held so far. Great too was the noise of the show, so that the worthy folk of Windsor must indeed have wondered whether the much-discussed funfair had arrived overnight. The burble of the crowd, the cries of the judges ring and the concourse of animal sounds were but the accompaniment to the treble of petulant petrol two-strokes and the deep-throated chug of the tractors. Electricity seemed nowhere in this picture. It made no noise to draw attention to itself, it made no unpleasant smoke to arrest the attention of passers-by, in other words it lacked sales appeal, that unknown quality, which invariably attracts the crowd. True, there was the stand of EDA and the Southern Board where electricity could be seen quietly getting on with the job of farming but they were fighting an unequal battle. With all types of farming implement being demonstrated with some form of paraffin or petrol or diesel engine, it is clear that a greater effort is needed if we are effectively to break in on the internal combustion mind of the farming community. Electricity certainly needs to make more noise.

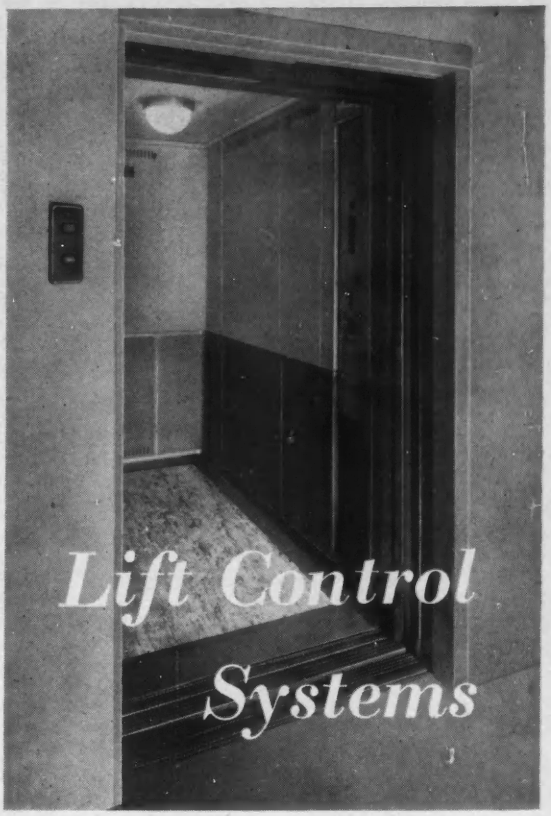
Meteor

Reduction to Two Main Types is possible

Says W. A. DIXIE

Chief Engineer, The Express Lift Co. Ltd.

STANDARDISATION of Lift Control Systems



THE apparently extensive range of systems under which passenger lifts can operate must be confusing at times to the architect or engineer who has to decide what is required for a particular building. If he seeks advice, he will quite likely get many different answers. This is due to several causes, the chief of which is that it is very rarely that anyone has had the opportunity, or taken the trouble, to analyse thoroughly the systems available.

After a comparative and functional study of the various methods of controlling passenger and goods lifts, an impression may be formed of fine distinctions and a lack of logical reasoning for the continued existence of some traditional practices.

In this article an effort is made to present the subject in a practical and simple way to demonstrate that there is a possibility of standardising the grouping and nomenclature of control systems in a self-explanatory and logical manner. The method used is to tabulate the systems in such a way that their relationship to one another and their function are seen at a glance.

Early Development

The original classification was into attendant-operated and passenger-operated systems. The early lifts always needed an attendant in charge, as a certain amount of skill in operation was required. The first lifts in common use were hydraulic and a rope passed through the car so that the attendant could operate the correct valves by pulling this rope up or down according to the direction in which it was desired to travel. To stop the lift, the attendant held on to the rope, and due to the motion of the car, this had the effect of closing the opened valve. The accuracy of stopping was dependent on the skill of the attendant.

When the first electrically powered lifts were installed it was natural that at first the rope control should be retained. It was not long, however, before the electric supply was carried to the car by means of trailing cables. A car switch then replaced the rope for controlling the movement of the car. The car switch handle could be moved only from the neutral to the up or down position. As soon as the handle was released, it would be returned to the neutral position by springs. An attendant was still required.

The higher the speed of the lift, the more difficult it was for the attendant to judge accurately the correct instant for returning his car switch handle to the neutral or "off" position. This difficulty was overcome by using two-speed motors and giving the car switch high- and low-speed points in both directions of travel. The attendant could start the lift by moving directly over to the high-speed position in the required direction, but for landing he would first return his switch to the low-speed position and then finally release to the "off" position when the lift was on the low speed.

This type of operation is known as car switch control with manual stopping, irrespective of whether a one-, two- or multiple-speed motor or system is used. Intending passengers on the landing could register their calls by pressing the landing call button which registered the floor number on an indicator in the car. The attendant could reset the indicator when he had answered all calls.

The limitations of the car switch lifts operated by attendants soon became apparent on lifts in busy office buildings. The attendant had to watch his indicator of landing calls carefully and at the same time remember the floors at which his car passengers wished to stop. All this was in addition to concentrating on the efficient operation of the lift itself. Several improvements came to the attendant's aid. The landing calls were automatically cancelled on his car indicator as they were answered. The car would automatically slow and stop at the next floor after the attendant had

TABLE I. — EXISTING CONTROL SYSTEMS FOR ONE-CAR INSTALLATIONS

Single Call Controls		Multiple Call Controls	
Car Switch Control (A.O.)	Automatic Control (P.O.)	Collector Control (P.O.)	Signal Control (A.O.)
Car Switch Dual Control (Primarily A.O.)	Modified or Semi-Dual Control (Primarily P.O.)	Collector Control with Attendant Service (Primarily P.O.)	Signal Control with Night Service (Primarily A.O.)

A.O.—Attendant operation. P.O.—Passenger operation.

centred or released his car switch. This was the result of introducing switchgear to give automatic landing.

A demand soon became evident for a slow-speed lift which could be operated by the passengers themselves. As soon as the necessary switchgear was devised to stop the lift automatically at the desired floor, push buttons, one for each floor, were fixed in the car, together with a single call button at each landing. Provided all the entrances were properly closed, momentary pressure on one of these buttons would cause the lift to travel to the floor represented by the button pressed. There would also be a call button at each landing, the operation of which would cause the lift to come to the required floor, provided, again, that all entrances were closed and that the lift was not in use.

The greater accuracy of stopping at floors by using two-speed motors was soon applied to passenger-operated lifts, but the whole operation of floor selection, slowing to a levelling speed, and stopping, had to be automatic.

The limitation of these passenger-operated lifts was the "taxi service" they gave from one floor to another irrespective of any service that might be required from an intermediate floor. In some situations it was a convenience if a car switch attendant-operated lift could be used by the passenger without an attendant during the slack periods of the day. This led to what was known as dual or car switch dual control. The car control panel carried all the equipment required for both systems, together with a key-operated transfer switch. When attendant-operated, the landing call buttons operated the car indicator, and when passenger-operated they controlled the lift if available. Either the car switch or the floor buttons in the car were operative, but not both.

Some owners of automatic passenger-operated lifts wanted to improve their service at certain times by putting them in charge of an attendant. To make this a practical improvement, a call indicator was added to the car and a key-operated transfer switch. When the attendant took charge and set the transfer switch to attendant-operation, the landing buttons were changed over from operating the lift to registering calls on the car indicator. The attendant operated the lift by means of the floor pushes in the car, i.e. a push button for each floor, in the same way as a passenger would do. This system was called "semi-dual" or "modified dual." The qualification of dual control was justified, since once the attendant had pressed a push for a floor well ahead, and a landing call then registered on his indicator for a floor nearer to him but in the same direction as he was travelling, the lift could not normally be stopped at the nearer floor. In other words, the service given was not quite so good as car switch dual.

TABLE II.—EXISTING CONTROL SYSTEMS FOR TWO OR MORE CAR INSTALLATIONS

Signal Systems Primarily for Attendant Operation	Collector Systems Primarily for Passenger Operation
2-Car Signal Control (Duplex Signal)	2-Car Collector Control (Duplex Collective)
3-Car Signal Control (Triplex Signal)	3-Car Collector Control (Triplex Collective)
2-Car Signal Control with Night Service	2-Car Collector Control with Attendant Service
3-Car Signal Control with Night Service	3-Car Collector Control with Attendant Service
4 or more cars with signal control and a supervisory system with night service	—

Signal and Collector Systems

Signal control was a natural development of the car switch attendant-operated lift. The landing calls or signals were still registered on the car call indicator, but were also registered in the controller located in the machine room. The controller was so arranged that it stopped the lift automatically to answer these landing signals. The landings had two call buttons, one above the other. The upper button, marked "up," was pressed if the passenger wished to travel upwards; the lower button was correspondingly marked "down." This enabled the controller to distinguish between up and down landing signals so that when the car was travelling upwards it would answer only up calls and ignore down calls, and vice versa when moving downwards.

TABLE III.—SUGGESTED STANDARD CONTROL SYSTEMS

Single Call Control (Full Automatic Dual)		Multiple Call Control (for 1 car—signal collector)		
Passenger Single Call Control (Automatic)	Attendant Single Call Control (Car Switch)	Multiple Call Control for 2 cars	Multiple Call Control for 3 cars	Multiple Call Control with Supervisory System

This ability of the controller to register and store landing calls was extended to include the car passengers' destinations. As the passengers entered the car, they each gave their floor destinations to the attendant and he registered them by pressing the corresponding floor buttons on the car control panel. With power-operated doors, the attendant's duties in a signal control lift were reduced to operating a starting handle in the direction in which the lift was to travel. All the stopping of the car (both for passengers waiting on the landings and for those travelling in the car) was looked after by the controller. The result was a great improvement in the efficient handling of the traffic. Landing calls were not overlooked and passengers were not taken past their floors, as happened with car switch control.

The circuit principles evolved to bring about this registering of landing and car calls, could now be used to improve the simple passenger-operated or automatic lift. Just as the car switch lift became the signal control lift, in order to handle a greater number of passengers, so the automatic lift became the collector lift to give a lift service to a greater number of people.

The collector lift was arranged to collect passengers from intermediate floors who had put in calls for the direction in which the car happened to be travelling. Thus intending passengers on the landing used "up" and "down" buttons just as for signal control lifts, and with the same result. As the passengers entered the car, they would register their own car calls, since there would be no attendant in a collector lift. Each time a passenger entered a car and registered a car call, the lift would start and would very likely stop on the way to collect others wishing to travel in the same direction. If the last car passenger got out and there was another landing call waiting to be answered, the lift would automatically start, after a suitable interval, to answer that call and so on until every call had been met.

It will be quite obvious that from the design and equipment point of view these two controls (signal and collector) are very similar. Therefore, when the need arose to be able to operate the same lift as a signal or collector lift, the amount of additional equipment needed was very small. However, fine distinctions were drawn. For instance, a lift which was generally operated by an attendant, but only occasionally by the passengers, was known as a signal control lift with night service, since it was generally only at night time that passenger operation would be required. Likewise, a lift which was generally operated by the passengers, but had the ability to be operated by an attendant for extra busy periods or special occasions, was known as a collector control lift with attendant service. To preserve the illusion of a difference in systems, the collector lift had an "up" and "down" button in the car for the attendant's use, instead of the starting handle of the signal lift. There were also other minor differences which did not really merit the retention of so many differently named systems. The desire for simplification in nomenclature has had good results, as will be seen a little later on.

Grouping Control Systems

Meanwhile, it is as well here to recapitulate and show in tabulated form the existing control systems already outlined. These are seen in Table I. It will be noticed that there are two methods of operation, i.e. attendant and passenger, resulting in four basic control systems and four combination or dual systems.

These systems can be shown in another way. Table I groups car switch and automatic controls together and denotes them as "Single Call Controls." This is logical, since the lift system in each case cannot deal with more than one call at a time. It also groups signal and collector controls together under the heading "Multiple Call Controls." The reasoning here is due to the ability of the lift system to register a multiplicity of calls and to continue in operation until all calls in the system have been answered.

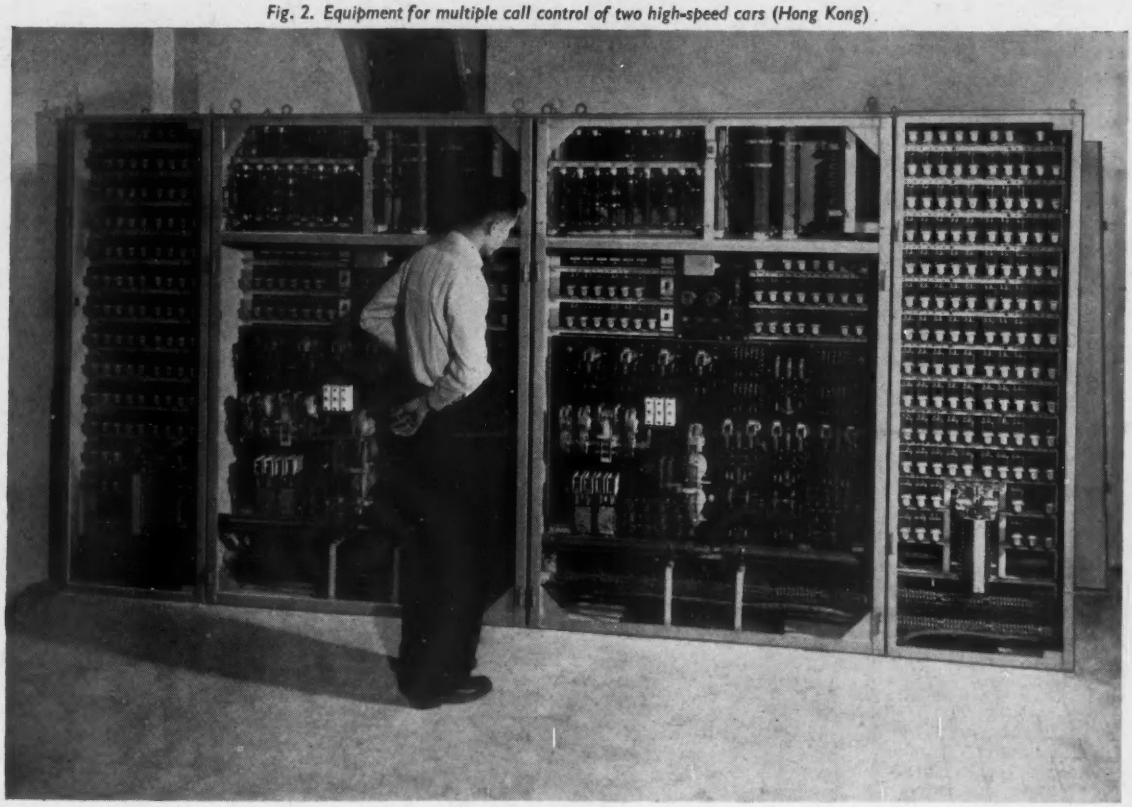
In the early days of the development of electric lifts, the emphasis was on the difference in capital cost between an attendant- and a passenger-operated lift. The extra equipment needed for an automatic lift was expensive and its upkeep added to the maintenance costs. In those days, wages for an attendant were low and interest on capital was high. Today the position is reversed. When the multiple call systems are considered, it has been pointed out already that there is very little difference in equipment, and so in first cost, between an attendant-operated and a passenger-operated lift. However, there is a decided difference in the amount of controller equipment required between a single and a multiple call system. There is also a marked difference in the type of service which the two kinds of lifts can give.

It is therefore suggested that a more up-to-date picture would be drawn if the emphasis on operation, with or without an attendant, were dropped in favour of single and multiple call systems. Herein lies the real difference in type of service given and in the cost of the system. In other words, instead of four basic systems such as car switch, automatic, signal, collector, together with their several combinations of dual control, there could be a reduction to two principal systems with a minimum number of variations.

Inter-Connected Control Systems

It is axiomatic that when two or more lifts are adjacent to one another so as to form a single vertical transport unit, then their individual control systems must be so interconnected that they function as a whole, rather than as separate units. It is also generally agreed that such installa-

Fig. 2. Equipment for multiple call control of two high-speed cars (Hong Kong)



tions should use signal or collector control lifts. Table II shows the systems in use for two, three, four or more car banks, together with their respective dual control systems.

It has already been pointed out that signal control with night service and collector control with attendant service are very similar in equipment and operation. The same similarity holds good irrespective of the number of cars in the groups of lifts. However, for two and three car banks, there exists a choice of eight different controls, as set out in Table II.

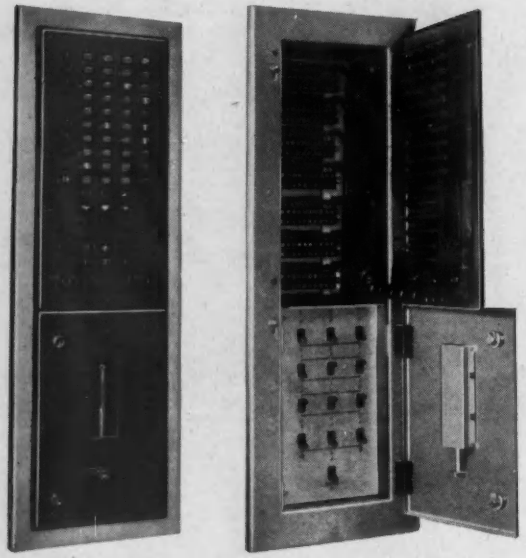
There is no point in tabulating the various systems offered in conjunction with four or more cars, because, being proprietory, their names bear little connection with their operation. These names are evidently chosen with an eye to their supposed sales value.

The alternative descriptions, "duplex," "triplex" and "collective" are tabulated. The styles "duplex" and "triplex" are somewhat restricted, although an attempt has been made to use "quadruplex." Fortunately, for more than four cars, no attempt has been made to extend this style. The word "collective" is unfortunate when used with the adjective "selective" to distinguish a directional collector control from a down collector control. Down collector control is a special form of collector control in which the collector feature functions only while the lift is travelling in the down direction. It is sometimes used in flats when all landing calls above the ground are assumed to be for a down direction of travel. A directional or selective collector control denotes that the collector feature functions for both directions of travel.

Single Call Systems

Standardised single and multiple call controls are shown in Table III. Before studying this, the present-day requirements of single call controls will be analysed.

Very few will deny that car switch control is not nearly so popular as it was, say, twenty years ago. On the other hand, automatic control operated by attendants as well as by passengers is gaining in popularity. This is a perfectly natural development. The operation of automatic lifts is now very reliable and the equipment required can be quite simple and easily maintained. It is also obvious that when a car switch lift starts a journey, the attendant knows to which floor he intends to travel. It is much easier momentarily to press a push for that floor than to hold a car switch over in the correct direction until just the right moment of release. This is especially so in modern passenger cars with solid doors. The attendant then has to judge the right moment for releasing his car switch by carefully watching a car position indicator.



Figs. 3 and 4. Combined indicator and service control panel

It may be contended that with a car switch the attendant can change his mind about that original floor destination at any time before he releases his car switch. It is quite easy to introduce the same facility into a push button operated lift. While the car is travelling, the pressure of another floor push can be arranged to cancel the first destination and substitute the second, provided the car has not already passed the point at which it must slow down in order to stop at that floor. This added facility has the effect of converting the service given by a modified or semi-dual control to that of a car switch type of full dual control.

The single call control would always have a full set of floor pushes in the car, also a call indicator with a transfer switch. The lift could be operated by pushes, with or without an attendant, and in each case the service given would be equivalent to that of a car switch or automatic lift, but with an attendant less skill would be required.

Many factory managements do not favour a vertical transport system which ties an attendant to a lift for the whole day. They prefer any one of a number of employees to be able to use the lift when necessary, but they require the lift to give the service of an attendant-operated lift when in use, so that landing calls are registered in the car. This is quite simple if the driver just pushes floor buttons instead of having to be trained to use the car switch. The cost of such an attendant-operated lift is greater than that of the old car switch type, but with modern floor selection equipment the extra is not much and is well worth while.

Once this type of push button control is accepted, it will be realised that all the equipment is present for the ordinary passenger type of operation. Many lifts have been installed with car switch control, and then, due to a change in labour conditions, have had to be altered to dual control.

The cost of a single call control lift is very little more than that of a simple automatic lift, but is much more flexible in operation. This system is now available and is sold under the description "full automatic dual control," to avoid a violent break with the orthodox name.

It is accepted that in certain special cases, as, for example, the installation of a large number of lifts in subsidised municipal flats, where the type of operation will obviously never need to be changed, and where the first cost is of paramount importance, the single call system should be used without the small extra cost required for the facility of changing from passenger to attendant operation. Such a system would be known as passenger single call control and is, of course, the old automatic control. There would probably be some demand for this small saving in cost on some goods lifts and small office lifts. It is only the car indicator and transfer equipment that is saved.

There might also be a demand, for a time, for the simple goods lift operated by a car switch or continuous pressure "up" and "down" buttons in cases where the lift is not often used. The speed in this case is very low and someone is easily trained to use the lift when required. This system is merely a further restriction of the flexibility and easy operation of the normal single call lift and would be known as attendant single call control. Unless a car position indicator is required, the whole of the floor section equipment is saved, also floor pushes in the car.

A two-floor lift with "up" and "down" buttons in the car is still a true single call lift with very simple equipment, by reason of the small number of floors it serves.

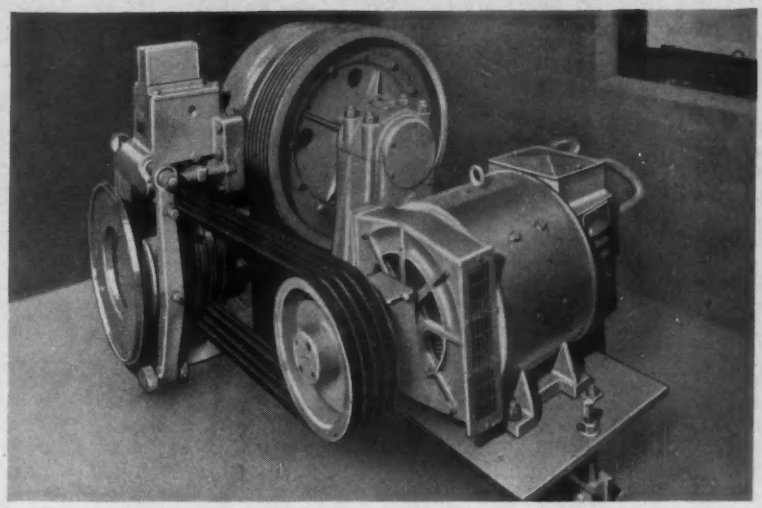


Fig. 5. The geared machine of a medium speed office lift with a variable voltage motor driving through vee belts on to a worm reduction gearing

Multiple Call Systems

From what has already been said, it will be realised that the grouping together of signal and collector control with their combinations of dual systems, is already an accomplished fact so far as equipment is concerned. The continuation of the various distinctions is artificial, and even if it has sales value, it has no benefit for the owner or the designer who is trying to standardise to the advantage of both maker and user.

It may be possible to purchase collector lifts more cheaply than signal lifts, and similarly collector with attendant service more cheaply than signal with night service, or vice versa, whereas the difference in essential equipment is more imaginary than real. If there is an appreciable difference in the equipment used, it must be due to its inherent inflexibility. It is also a fact that this type of lift increasingly requires the dual feature. Consider the lifts in a busy office building; if they are installed for attendant operation only, the whole activity of the building can be paralysed by the absence of the attendants. The dual feature eliminates this contingency. For this and other reasons the old idea of one only of a group of signal lifts being capable of giving a service without an attendant, is obsolete. It should be possible for the whole group to be able to give such a service. It is not surprising therefore that the multiple call system is now available, but again, out of deference to traditional practice, it is known as signal-collector control.

In a group of multiple call (signal collector) lifts, any of them can be operated with or without attendants. In a group of, say, three lifts, at the same time two can be operated with an attendant and the third without, or vice versa, as well as all on attendant operation or all on passenger operation. The owner has thus got an installation of maximum flexibility right from the start, without the danger of finding at a later date that his installation has too rigid a control system, and this at a price little, if anything, above that for signal or collective control.

Multiple call lifts can operate on a one, two, three or more car system, i.e. there can be a multiple call control for one car, two cars, and so forth. The landing call system is common for a group of lifts and the control system directs the cars in answer to the landing calls so that they are reasonably spaced. By this means, the waiting time of potential passengers is evened out to a low average, but at the same time car passengers are given a certain amount of preference in the matter of starting the cars from the main parking floor.

There are a number of features which should be common to all multiple call lifts. One of these is what is often termed "highest call reversal." It means that a car will not necessarily go to the top of its possible travel. It will only go as far as the highest call registered before reversing its direction of travel. Another feature is the postponement of landing calls so that they cannot stop the car when it is already full. When this feature is used, the landing calls automatically become effective again as soon as the car has stopped for the next car call. The assumption is, of course, that the car has stopped to unload some passengers and so is no longer full. On attendant operation, the feature can be effective by automatically weighing the load in the car. Since many multiple call lifts are only used without attendants when the traffic flow is very small, the likelihood of the cars getting full is slight and the extra expense of the automatic weighing device is not required.

Supervisory Systems

The service given by single call passenger-operated lifts has been likened to a "taxi" service, since it only caters for one call at a time. However, once the taxi (in this case the lift car) has been obtained, then the passenger can be sure of being taken straight to the correct floor without any regard to the requirements of other potential passengers. The service of a multiple call lift can be likened to that of a "bus." The bus will keep stopping on the way for waiting passengers as long as it has some spare capacity. When a fleet of motor buses is in operation along the same route, some additional control is required to ensure an efficient service. The buses are made to run to a time-table or schedule.

Banks of lifts with several cars can be likened to a fleet of motor buses. Such groups of lifts have many control features in common, in spite of the brilliant assortment of names used by the few makers of these highly developed examples of the art. They are all basically multiple call (signal collector) lifts with controlled despatch from the parking floors. The object of the controlled despatch is to space the cars so as to regularise the service given to each floor in each direction of travel, or to meet the special traffic flow of a particular time of the day. There are a great many variations in the methods used for altering the despatch of cars according to the traffic needs at the moment. For instance, the cars are despatched to high and

low zones of the floors served, for increasing the efficiency under certain traffic conditions.

Whatever the name of the control, it can be regarded as a supervisory system for automatically despatching the cars from parking floors and restricting the floors served. Hence, there appears to be good reasons for using the term "supervisory control." At the same time, it is clearly understood that the supervisory system is applied to a group of multiple call lifts.

There is a growing need for automatic supervisory systems. Problems of varying traffic conditions arise at different times of the day. The lifts must therefore be able to adapt themselves to meet these conditions with as little human supervision as possible.

In the majority of buildings, there are three major types of traffic conditions: first, the "up peak" period when people come to work in the mornings; second, the "off peak" period, during the greater part of the day, when there is normal two-way traffic; third, the "down peak" period when people are leaving the building in the evening.

It can also be contended that there are three minor types of traffic conditions. Two of them can be encountered during the midday period and are sometimes regarded as a variation of the "off peak" period. As the greater number of people are leaving the building for lunch, there will be a "heavier down" period, and after lunch this will be reversed by a "heavier up" period. After business hours, the very much reduced lift service required can also be regarded as a night service period.

It is natural that the amount of automatic supervisory control required will vary with the type of building and the size of the installation. The greater the number of cars and number of floors served, the more essential it is to control the movements of the cars according to the predominating direction of traffic flow. This can all be summed up by stating that the supervisory control, if automatic, should be designed to adjust the operation of the lifts according to the density and direction of calls. All shades of peak periods will then be catered for. In other words, just another case of simplification.

Conclusion

This simplified system of controls for electric lifts can be brought about by a little co-operation between purchasers and manufacturers, to the benefit of both parties. Very often the purchaser is confused by the variety of systems offered today at an equal variety of prices. Instead of having to weigh up carefully all the subtle differences and accurately forecast his probable requirements extending over the life of the lift, the prospective owner is offered a choice of two main systems, i.e. single call control or multiple call control, and the distinction between their operation and price makes it easy for him to select which he wants. In addition, having made his choice, the owner will find a reasonable degree of flexibility in either system which will cover any normal change in the manner of operating the installation.

It is hoped that this standardised system of controls for electric lifts will be considered in official circles, as its adoption cannot do otherwise than promote a much-needed measure of rationalisation. Finally—and what is, perhaps, more important than all else—in the export market standardisation of products and clarification of sales literature are essential for success.

Variable Power for Accountancy Testing

TESTING a range of accounting machines requires a wide range of frequencies and voltages. To provide these in a single machine to a good standard of accuracy is no easy task, and there is, therefore, considerable interest in the 10 kVA motor-alternator set which has been supplied by Electro-Dynamic Construction Co., Ltd., to the Croydon factory of Power-Samas Accounting Machines Ltd. The set gives a frequency range 25 to 65 c/s and a voltage range 100-250 V, with 5% accuracy over the full load range at any setting.

On the right is the control cubicle for the variable-voltage variable frequency alternator. A general view of the installation is shown below

Essentially, the set consists of a revolving-armature alternator driven by a compound-wound d.c. motor. This in turn is supplied from a Ward-Leonard set. An Isenthal type automatic voltage regulator provides voltage control. This regulator is of special design, and includes a nine-position voltage range selector switch with a slider-type field rheostat for fine control.

Speed control is essentially a matter of field control on the generator of the Ward-Leonard set. A pilot exciter is used, and is controlled by a servo-regulator. Speed input is obtained from a permanent-magnet type tachometer generator, the output voltage from this being compared with a reference voltage from a dry cell. The out-of-balance is fed to a control circuit, which includes features giving smooth acceleration to the desired speed, and so to the field of the pilot exciter.

As the accompanying illustrations show, the controls are assembled in a cubicle containing the starter for the induction motor driving the Ward-Leonard set; the excitation supply for the generator, d.c. driving motor and the alternator; the alternator instrumentation; the automatic voltage regulator, and finally, the electronic servo-regulator used for frequency control. The starter is of the auto-transformer type, while excitation supplies are taken from an air-cooled metal rectifier giving full-wave rectification with output at 235 V d.c. An interlocking relay ensures that the main contactors open if there is a rectifier circuit fault.

Coal Fired Gas Turbines

D.S.I.R. FUEL RESEARCH REPORT DESCRIBES PROGRESS IN INVESTIGATIONS

COAL fired gas turbines are given extensive attention in "Fuel Research, 1953," the Annual Report of the D.S.I.R. Fuel Research section, published by H.M.S.O. last week. At the Fuel Research Station, work is continuing on the design of combustion chambers, while extra-mural work on the project is being conducted by the British Coal Utilisation Research Association under a D.S.I.R. contract.

One of the objects of the latter work is to develop a slagging cyclone type of combustion system and gas cleaning equipment suitable for open cycle gas turbines. It is desired to burn high-ash coal fines, and the main difficulty encountered has been the accumulation of solidified slag at points where the temperature keeps the ash soft but not fluid. Detailed changes in the design of the experimental combustion chamber have greatly reduced the severity of this trouble. Experiments with coals having a range of ash contents from 7% to 28% indicate that variations in ash content do not have a significant effect on combustion characteristics.

For gas cleaning in connection with open-cycle gas turbines, work has been concentrated on the development of suitable types of cyclone dust separators. Recently, work has been concentrated on a collector with a long narrow tangential entry, outlets at both ends, and also a means for removing the collected dust at both ends. This has given high collection efficiencies for particles below 10 microns.

At the Fuel Research Station, straight-through and vortex combustion chambers are under investigation. For the former design, the principal difficulty remaining to be overcome is the deposition of relatively small quantities of ash on the refractory lining used in the upper part of the combustion chamber. These deposits consist of light, loosely attached ash. It seems that the existing design could be applied where daily cleaning—manual or by soot blowing—is possible, but not where long intervals occur between cleaning operations.

Work has been started on a pressurised version of the straight-through furnace, working at about four atmospheres. When design work and construction has been completed, the furnace will be erected at the National Gas Turbine Establishment.

Experimental work on a vortex chamber has produced detailed improvements in efficiency, but some new difficulties of dust deposition have unfortunately shown themselves as well. There are indications that the introduction of primary air and fuel from ports around the periphery of the chamber may have advantages over feeding them through inclined nozzles through the top plate of the chamber, which is the present practice.

Boilers

Work on the formation of external deposits in water tube boilers has been continued in conjunction with the Boiler Availability Committee. Until recently it was believed that boilers fired with pulverised coal were almost immune from trouble due to bonded deposits on the external heating surfaces, but it is now known that deposits are formed when coals of a high chlorine content, 0·6% and above, are burnt. At present, little or no high-chlorine content coal is used for p.f. firing in this country, but exploitation of new seams may alter the position.

Investigation suggests that the deposits differ from those found in stoker-fired boilers in that the alkali content is fairly low while the calcium content may be high. The suggestion is that calcium chloride acts indirectly as a bonding agent by being converted to calcium sulphate after deposition on the boiler tubes. Deposits of this type have been described as "calcium bonded." The presence of calcium chloride in boiler flue gases has been investigated, and it has been shown that the formation of the salt from ash constituents and from hydrochloric acid present in the flue gases is possible. Laboratory experiments have suggested that increasing amounts of sulphur tend to suppress the formation of calcium chloride. It seems that there may be a critical sulphur/calcium ratio of about two to form deposits bonded by calcium salts.

Although stoker-firing is now of much diminished importance, investigation into bonded deposit problems associated with this technique are continuing. It seems that the position of the high temperature heating surfaces in the boiler has an important effect on the formation of deposits. It has been suggested that there are advantages in pitching the tubes widely, with axes as nearly parallel to the flow of gas as possible, and in allowing a liberal space for flue gas to by-pass local formations of deposits at the superheater inlet.

Domestic Heating and Air Pollution

The year saw the adoption of new arrangements for the testing and recommendation of solid fuel appliances for use in "average dwellings" a development which must affect the electrical industry. All appliances listed as "recommended" are to be re-tested, and a new list prepared. It is stated that the new standards set as the pre-requisite for the recommendation of solid fuel appliances "while high, are known to be attainable in practice." Some dimensional and constructional standards have been introduced to supplement the thermal tests in some cases. Full compliance with the new standards is required on both coal and coke.

Quantitative results on the room-heating efficiency of appliances are expected from tests now being conducted in a calorimeter cabinet. Tests are being continued for periods of four or five days, with the fire banked overnight. Attention is being paid to the effect of relative room air tightness on burning rates.

The Fuel Research Station is concerned with many different facets of the problem of air pollution; indeed, there is a close relation between the station's general interest in efficient use of fuels and its work for a cleaner atmosphere. In the Report of the Fuel Research Board, which accompanies the Station report, Sir Cyril Hinshelwood, the Chairman, emphasises that although it is practicable to reduce pollution of the air by industrial smoke, the fact remains that nearly one-half the pollution by smoke arises from coal burnt in household grates. There seems no early prospect of designing an open coal fire that will emit little smoke.

Much measurement and survey work concerning pollution is being carried on by the Station. The survey is paying particular attention to the area surrounding Bankside power station, where flue gas washing is used to remove sulphur compounds.

notes on wiring

by Megohm

I HAVE followed with interest, and in some cases concern, the many developments to aid in the construction of buildings. I am thinking principally of the internal walls, as the exterior construction of houses, etc., has not altered greatly.

The development of light partition walls, and subsequently of lighter ceiling construction, has been very rapid indeed but I regret to say that during the progress very little thought has been given to the electrical services requirements. I say *very little thought* but this usually develops into quite a bit of thought when the man on the job is presented with the problem of getting his conduit runs installed to certain positions. Let us consider this type of partitioning which, of course, is not capable of carrying structural loads. In consequence the load bearing walls are sited farther apart and the roof and ceiling construction is affected. There are various types of light partitions ranging from the solid plaster type to that which is fabricated by compressing paper, resin and hessian and in its final form resembles, in section, the familiar pot brick but, of course, in a larger size.

Cutting Chases

With the solid plaster type a chase can be easily formed by means of an abrasive wheel and the whole made good with plaster in the normal way. Sections with chases preformed are obtainable by arrangement. This type presents little difficulty to the electrical trade except where 15 amp switchsocket boxes are required to be set flush in the wall. Great care has to be taken when this is being done, for most of these boxes are quite deep and very little of the wall will remain when the recess is cut. Although this does not greatly affect the strength of the wall, it is a recognised fact that chases in plaster which are made good are never completely successful. Another type of partition has a plaster core, faced on each side with hardboard. Each section has a tongue on one side and a groove on the other to cater for butting the sections together. The hardboard facings make it difficult for dropping or rising to switch and socket positions and the method advocated by the experts to overcome such difficulties is to butt two groove sides together, thus providing a recess into which conduit and outlet boxes can be accommodated. This is not entirely successful but at least goes some way to solve the problem.

There is one type of partitioning which is composed entirely of treated straw, suitably fire-proofed. This type does not lend itself to chasing either, and calls for special treatment where conduit runs are involved. At such positions, the sections of partitioning are kept apart to accommodate the conduit and boxes and the spaces later filled with plaster as required. It is possible with the compressed paper type to install conduits in the hollow section and cut the wall to fit outlet boxes. A special method of fixing boxes in this type of partitioning must be employed because of the lack of anything solid in the core of the wall.

All these types of partition walls seriously affect the electrical services and I repeat that the manufacturers have given little consideration to the requirements of the electrician. The drill, so far, has been for the manufacturer of the partitioning to present his product to the architect who in turn incorporates it in his scheme, and the result is a long discussion as to the best way of concealing the conduit, etc. After some method has been devised it is generally left to the foreman electrician to carry it out in practice. Normally by the time he has successfully done the job, the heating engineers or plumbers have installed, *on the surface*, a large unsightly pipe, which the architect never appears to notice. I feel certain that many of my readers have met this situation.

P.V.C. or T.R.S.

I realise that certain people will say that the answer is to use t.r.s. or p.v.c. covered cables. There is no reason why these cables should not be installed in the partitioning described, but there are still those among us who prefer the steel conduit system. The use of steel conduit with such walls does present a problem, and the introduction of plaster depth boxes does help considerably. I do, however, feel that there is some lack of co-operation between the electrical manufacturer and the partition manufacturer and I consider that they are not fulfilling their obligations to their customers by lagging behind the times in their ideas. I also realise that it would be almost impossible to produce partitioning with a number of voids covered by removable lids in order to accommodate services, but surely some happy medium could be reached.

The many scientific developments in sound proofing and insulation of walls will tend to make these walls even less thick than they are at present. The present average thickness is two inches and this allows little working space now. Any further decrease will practically dictate the production of some form of built-in wiring channel which, of course, would mean that sockets and other fittings could not be sited to suit individual requirements. With the new types of ceilings, too, the question of space is a pressing matter which requires urgent consideration. It is not always good practice to cut certain of these ceilings where outlet boxes are installed and the reluctance of the architect to have this done and the edge of the holes reinforced seems trivial. Of course, most lighting points land in the centre of rooms and presumably at this position the ceiling has few supporting members and any cutting affects the tension of the ceiling. It is time that this whole matter was gone into thoroughly and the man on the job invited to voice his opinion for consideration by the manufacturers.

Stencils

In these Notes on 1st July I mentioned that there were on the market today stencils which grealy assist in the marking-up of working drawings. I have received several enquiries about obtaining them. The stencils and stencil pens are sold under the name of UNO Pen Stencils, and are manufactured by Messrs A. West and Partners Ltd, 36 Broadway, London, S.W.1.

ELECTRONICS IN INDUSTRY

RADIO ENGINEERS EXPLORE A WIDE FIELD

As experience with the operation of electronic computors grows, their latent possibilities for industrial application are further realised, and hence the series of papers on these new tools at the first session of the 1954 Convention of the British Institution of Radio Engineers—held last week at Oxford—was concerned primarily with their utilisation rather than the electronics involved in their operation. That they have considerable value for accountancy work, providing means of production forecasting, is well established, as three papers bore witness. Their application to scientific and engineering activities however, is an aspect too important to be ignored, and of the problems involved, that of their economic use ranks of primary importance.

Some of the many factors involved in ensuring that electronic computors are economically employed were dealt with by R. K. Livesley, M.A.(CANTAB.), PH.D., who was concerned solely with calculations encountered in scientific and engineering work, based largely on experience with the Manchester University's high-speed digital computor.

Types of numerical problems

For computing, numerical problems which arise in engineering drawing offices, or research laboratories, fall into two categories—those involving a finite amount of repetition work, and those in which the repetition work occurs indefinitely. Nearly all "research" problems belong to the first category and whilst the amount of work required beforehand is known, an electronic computor programme becomes redundant when the calculation has been completed, and must therefore pay for its creation in a relatively short working life. The amount of repetition involved usually determines whether digital computation is the optimum method of carrying out the work. In this type of calculation the end product is always a table of numbers exemplified by the tabulation of "type" solutions covering practical parameter values of a particular engineering product. This kind of work is well suited to a digital computor, but is only practicable when the number of independent parameters is small.

Most engineering problems however, relate to certain stereotyped problems which recur at frequent intervals and as such, fall in the second category. Engineering firms engaged in contract work are the most prolific source of this type of problem, each product having to be designed individually to specific requirements. Such calculation, usually taking the form of an analysis of a series of trial designs, are essentially the application of a standard form of calculation to various sets of initial data, as in transformer design. It is in this field that the digital computor is likely to prove most useful. A standard programme converts the computor into a special-purpose machine for carrying out a certain kind of calculation, enabling each individual programme to be solved as easily as a mechanical part is made on an automatic lathe.

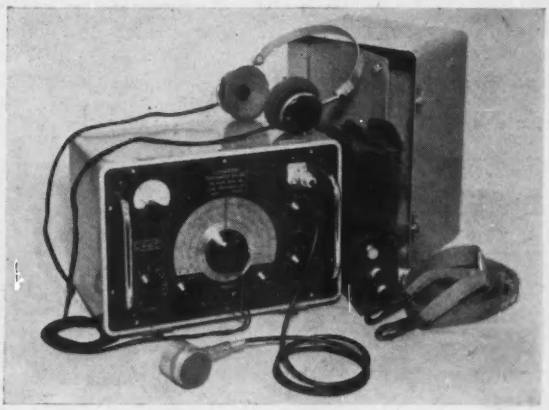
If such a programme is to be used repeatedly on many different problems, time spent on mathematical research and programme design is a worthwhile capital investment. As computor running time offers no limitations, the programmer may then devote greater energy to devising a programme capable of general application rather than a slightly faster programme of only limited application. Programmes should be designed to minimise human error, and for this reason basic parameters should be fed directly into the machine, rather than data derived from them by human agency. Moreover, as usually the resulting data are far more numerous than the initial parameters, many more quantities have to be prepared for input to the machine. For similar reasons, the programme should allow for the machine to print out the final answers.

Correct mathematical techniques

Success of the programme depends on the correct mathematical technique being employed, as the electronic computor is obviously unable to draw on the intuition and experience of a human operator who is mainly concerned with minimising the time spent on calculation by hand. Most suitable methods of analysis are characterised by formal simplicity, representing a return to the techniques of classical mathematics. A statement of the problem in logical mathematical terms usually produces a scheme of analysis possessing form and symmetry much more suited to the computor programme than the intuitive and short-cut methods of the human computor. Moreover, most correctly formulated problems usually consist of standard mathematical processes for which routines already exist.

In correctly assessing computors as instruments for industrial mathematical work, a knowledge, in functional terms of the basic theory and mode of operation is a necessary requirement for would-be users. To this end the paper by B. D. Dagnall, B.SC., M.S., and R. L. Michaelson, F.I.A., describing digital computors in general outline, was directed. As the fundamental adding device of computors is bi-stable, such as a valve or a magnetisable spot on a surface, it is thus more convenient to employ bi-stable (binary) arithmetic as the system in which they perform calculations.

Numbers in the binary scale may then be represented by electrical pulses, the computor processing these pulses in an ordered manner simulating an arithmetical operation. In order to relate pulses in any given number, a master pulse frequency generator supplies reference points, the



A portable ultrasonic flaw detector. The piezo-electric transmitter head is seen in the foreground. (Dawe Instruments Ltd.)

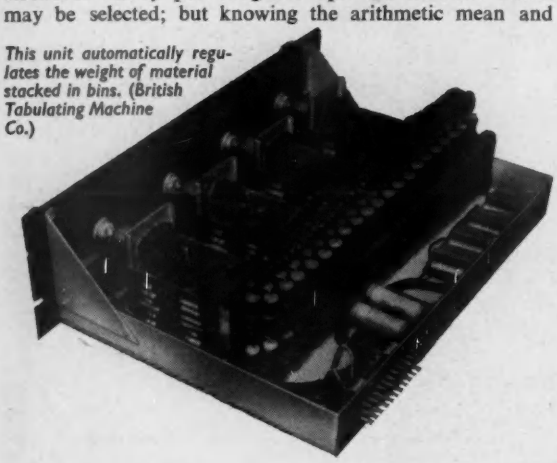
time between successive points being the minor cycle. The function of most of the processing devices is defined in terms of the conditions necessary on the input lines to produce a pulse in the output. However, the four basic arithmetical operations may only be performed on numbers provided there is means to store the numbers until they are required. Although valves may be used as stores, delay lines, or more frequently magnetic drums and cathode ray tube screens are most commonly employed, all having a high storage capacity. A combination of store and adding device produces an accumulator, capable of adding a new number entering the input to the contents of the store, and reading out the total in the store to another component when required.

Selection of Processing Units

Selection of the devices to be brought into play is achieved by means of gates in which an input pulse only results in an output pulse if a pulse occurs simultaneously on a control line. For subtraction a "notter" is used, emitting a pulse when none exists on the input and vice-versa, when the control is operated. During each minor cycle, the operation of appropriate gates is effected by a master control unit which issues instructions in the form of pulse trains. After the completion of a minor cycle the control unit automatically seeks the next instruction and then operates gates to perform the necessary functions accordingly. For any given calculation the control unit must read a programme of instructions in order, the instructions being expressed numerically and hence capable of being stored. Since they are numbers, the computor may perform any arithmetical operation on them, the feature which gives computors their high degree of automaticity.

Although typical applications for such computors are the calculations involved in engineering design, electronic computors modified to accept information in the form of statistics become instruments capable of providing quality control of continuous industrial processes. Such a system was described by P. Huggins, A.M.BRIT.I.R.E., quoting a practical example of the application of automatic statistical control in cable manufacture.

Products manufactured continuously show, on examination, a variation about the norm, the variations, in the limit, largely corresponding to the Gaussian distribution curve which occurs repeatedly in physical problems. Not all production distribution curves are Gaussian, although the majority are close approximations and definitely symmetrical about the norm. However, this statistical uniformity gives manufacturers a valuable tool; not only is it unnecessary to test every article off the production line, statistical theory providing the optimum number which may be selected; but knowing the arithmetic mean and standard deviation of the distribution enables the frequency with which individual units occur in any desired scale of measurement to be forecasted.



This unit automatically regulates the weight of material stacked in bins. (British Tabulating Machine Co.)

Character of Automatic Control

In many production lines a skilled operator is employed making corrections in some part of the process, by altering a motor speed, gear ratio, moulding cavity size or similar physical variable. Any automatisation, therefore, must perform the measuring thinking and correcting process analagous to the human operator. Careful study of the production process and its "human controller" must precede design, which has then to consider the best means of obtaining information, providing an input, extracting statistical parameters, storage and other factors. Obtaining information of the trend of certain statistical data is assisted by the knowledge that, whilst the standard deviation remains appreciably constant for a given installation, it is only the arithmetic mean which varies. In its broad outline, the statistical computor then takes the form of sampled information fed into a discriminating system which classifies into either "positive error," "no error," or "negative error." A storage unit retains information corresponding to the net number of errors occurring since the last correction, an appropriate correction being made when the total number reaches a preselected figure.

Certain variables are incorporated in the computor, to determine the limits which are acceptable, information falling outside them constituting errors, the repetition ratio at which information is sampled, the number of errors which must obtrude before correction takes place (error selection), the degree of correction, backlash compensation, muting and "forgetting." Of the last two, muting suspends the correction for articles lying between the sensing device and correction point to ensure that subsequent information is that on which a correction has been made. The latter control ensures that the computor is not biased by trends which start but do not persist.

Ultrasonics as a Tool

Ultrasonic methods are now well established for a number of industrial applications, one particular operation for which they are well suited being that of detecting flaws in metal. This subject was dealt with by G. Bradfield, B.SC., who gave an account of recent improvements in the methods available developed by the National Physical Laboratory. Four aspects have been investigated by the N.P.L.—the use of barium titanate as a piezo-electric element, the use of heavy wedges for mode changing, applying mechanical and electrical damping to transducers and the provision of beams which may be steered—which are of considerable importance for industrial applications and the last three were dealt with at the Convention.

The propagation of waves in solids is somewhat more complicated than that of radio waves, the former having two modes. One mode is known as the rotational or shear wave and is formally identical with electromagnetic waves, whilst the other is irrotational or longitudinal. When a mechanical wave encounters an interface between two solids at oblique incidence, a change of mode takes place, with both transmission and reflection of both waves. In ultrasonic flaw detection, a perspex wedge is placed between the piezo-electric crystal transmitter and the surface of the steel under test to affect mode changing to produce transmission of shear waves in the steel. Due, however, to impedance inasmuch between the perspex and steel, the interface results in only some 20% of the input energy being usefully employed. To effect an improvement, a mode changer of heavier material is required, and particularly good results have been obtained with laminated

wedges built up of layers of metal cemented together with a non-metallic material.

Apart from this gain in power, closer matching also assists in increasing discrimination between near singularities and reducing the effect of surface roughness. The former is also improved by employing heavy damping material to back up the crystal, which reduces paralysis in the crystal which occurs under certain circumstances and veils echoes from flaws near the surface. Rough surfaces reduce the intensity of the wave both when it is launched into the specimen, and when returning to the receiver crystal, and as ultrasonic tests are now desired to be mandatory for boiler inspection for example, the condition of the surface can be seen to be of some importance. Improvements, however, have been obtained with a probe in which a monitoring crystal has been employed, giving indication of poor surface contact during the test. Work on steered ultrasonic beams has led to the development of a grooved crystal. Its elements are connected to a delay line to incline the wave front at angles of 4° or 8° to scan the specimen rapidly.

Another valuable use for ultrasonics is that of gauging wall thicknesses where only one surface is accessible, the system relying on the internal reflection of the transmitted wave at the far boundary. Standing waves are established, the frequency difference between the fundamental and second harmonic then being a measurement of the thickness of the specimen. Recent developments in practical gauging instruments were described by F. M. Savage, one important feature being the indication of resonance. Under ideal conditions the anode current of the output valve should double at resonance but usually only increases by some 1%, a rise which will be almost certainly swamped by the normal variation of the current as the circuit is tuned over the full frequency range. However, by frequency modulating the oscillator over a small range at audio frequency, resonance can be readily detected in a pair of head-sets or loudspeaker. Moreover, the use of a motor-driven capacitor to vary the oscillator frequency itself over a 2 to 1 range provides a means of giving automatic thickness indication. Alternatively, the frequency may be swept by an electrically variable inductor working on the saturable core reactor principle.

X-Ray Thickness Gauging

Where thickness measurements, however, have to be made on continuous processes, as in the close control of tolerances in hot or cold strip production. For this purpose, the X-ray thickness gauge has several distinct advantages, giving indication of the mean thickness over a given length of material passing through the gauge. Broadly, two systems of measurement are available, these being described in the paper by F. H. Gottfield and D. Tidbury. Both methods employ standard absorption wedges and a special X-ray tube producing two identical beams of X-rays perpendicular to each other. In the constant absorption method both beams pass initially through a set of identical wedges, the voltage on the two Geiger counters measuring the difference in absorption being adjusted until no out-of-balance current appears between them. The standard wedge in the measuring beam is then replaced by a wedge of thickness, which, when added to that of the strip is equivalent to the thickness of the original wedge. Any consequent variation of the nominal thickness of the strip will then cause an out-of-balance current between the Geiger counter as the absorption varies.

This method has the advantages of simplicity and speed of operation over the alternative, variable absorption, method, in which standards identical to the thickness to be measured are intially placed in both beams for adjusting zero, the standard in the measuring beam being then replaced by the strip. Whereas the former method involves only a change in the measuring standard to accommodate changes of thickness in the rolling programme, the latter requires the entire system to be re-balanced. The accuracy of the v.a. system, however, is high over a wide range of thicknesses, whilst the c.a. system has a constant accuracy giving a percentage accuracy which varies with the thickness being measured.

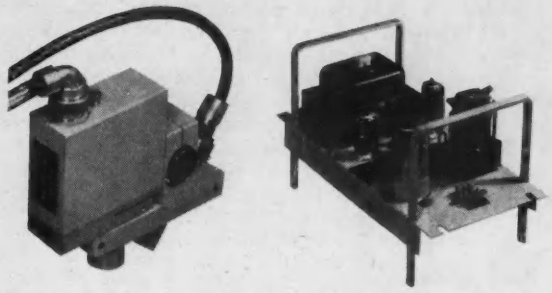


Photo-electric cells have a wide application for counting and controlling as shown by this unit. (Sargrove Electronics Ltd.)

Instrument Reliability

The introduction of nucleonic instruments with their associated electronic equipment into industry creates new problems of servicing in which reliability plays an important part. This question was explored by D. Taylor, M.SC., PH.D., who showed that the real problem of servicing remains one of design. Good design relies on good components, and his statistics show that failure rates are highest for orthodox components such as thermionic valves, resistors and capacitors. A recent review at an atomic energy factory where several thousand electronic instruments are in continuous use showed that more than 70% of the total failures were due to thermionic valves alone. In servicing, the system worked out for factories involves designating certain personnel for routine inspection of complete instruments and first-line maintenance. More involved repair work is carried on off-site, a fault being localised to the individual unit, which is replaced. A feature which can give the user some improvement, and is now being used, is the facility for complete and extensive test each time the equipment is used. By this means, the slow drift of valve characteristics and the like may be counteracted, with a reduction in the nuisance factor of these components.

As might be expected several papers dealt with individual applications of electronic control, one such being that by C. R. Bates, A.M.I.BRIT.R.E., who dealt with control of resistance welding. Some eight types of welding operation are in common use, ranging from the well-known spot and seam welding methods to the increasingly important "woodpecker" and "slope" techniques. The woodpecker control probably provides the most versatile of all applications of electronic control, as the process, in which a complete weld is made by using a number of current impulses, enables thicker material to be welded on the same machine, and a multiplicity of thin sections to be welded together. Whilst the weld current is interrupted the electrode tips are cooled, although this cooling has little effect on the temperature of the weld nugget on thick metal pieces during this period.

Control design, in general, has to provide for the addition of compensation for voltage and current variations which may arise due to supply fluctuations or by the effect of the

work itself on the inductance of the air-cored loop formed by the arms of the machine and electrodes. Where sequence controls are concerned, the faster operation of electronic equipment combined with the absence of moving parts has produced a tendency to reduce the number of mechanical relays in use. Moreover, switching-current surges, especially when non-ferrous metals or stainless steels are being welded, has now reseulted in considerable attention being given to synchronous control, in which electronic technique become essential.

With the development of efficient detectors or sensing organs coupled with the flexibility of electronics generally opens up, however, the possibility of replacing certain human operations in industry by completely automatic mechano-electrical operations. As shown by G. T. Baker, M.SC., the mechanical aspect of the problem reduces to two elements—a joint and a power source (or muscle) and his efficient mechanical arm demonstrated that the design is well within existing manufacturing techniques. Some of the flexibility of the human hand is provided by detachable elements which the "arm" selects automatically. Electronic techniques provide means of specifying the parameters defining any particular operation in the form which can be rapidly programmed.

Independent Enquiry into Supply Industry

AN independent enquiry into the electricity supply industry is to be instituted shortly. This was announced by the Minister of Fuel and Power, Mr Geoffrey Lloyd, during the debate in the House of Commons on the Gas and Electricity (Borrowing Powers) Bill which was held last Friday. The terms of reference of the committee appointed for this purpose will be "To enquire into the organisation and efficiency of the electricity supply industry in England and Wales in the light of its working under the Electricity Act, 1947, and to make recommendations." Subsequent questioning of the Minister confirmed that Scotland is to be excluded from the enquiry. Mr Lloyd told Mr A. M. F. Palmer that the enquiry was of quite a different order from the internal survey (the Carpenter, or Self, Committee) which had been taking place within the industry. Later it was stated that the Committee would hear representatives of the employees in the industry, amongst others.

Chairman of the Committee is to be Sir Edwin Herbert, a solicitor with wide business interests. He is to free himself from professional obligations within the electricity supply industry. Other members will be Mr F. C. Bagnall (Managing Director, British Nylon Spinners), Professor R. S. Edwards (an economist), and Messrs A. Healy (Director, Dunlop Rubber Co.), L. Robson (an accountant) and J. Tanner (lately president of the Amalgamated Engineering Union).

Earlier Mr Lloyd had discussed the probable increase in the demand for electricity and the ways of meeting it. He said it was expected that by 1960, electricity demand would be 54% higher than in 1953. The corresponding estimated increase in gas demand was 16%. It was to meet such a demand that the increase of borrowing powers for the B.E.A. from £700m to £1,400m was necessary. On the basis of present efficiencies, the expansion programme for electricity would require an extra 20m tons of coal a year, but owing to the increased efficiency of the new plant it was expected that this could be reduced to 14m tons.

The Minister emphasised that on the basis of present knowledge, it was through the electricity industry that use would have to be made of all the possibilities of nuclear power. It was possible that if the progress of atomic developments was as quick as was hoped, then construction of nuclear power stations of an advanced type would be undertaken before 1960. Preparing for this possibility, the B.E.A. had established a nuclear power branch in the engineering department, and had appointed a nuclear power engineer to a high post.

Further assistance for the industry to overcome the coal shortage was likely to come from the oil industry. The Marchwood power station has already been stated to be designed for alternative coal or oil firing. The Minister revealed that arrangements have been made for the Esso Petroleum Company to supply oil at a price which makes the cost of generation of electricity the same as if coal were used. Further surveys have been made of power stations on river estuaries which could be conveniently fed by tankers from the oil refineries. This survey suggested that a dual firing system would be technically possible by 1958-59 at estuary stations which would have a coal consumption of between 10 and 11m tons a year. It was emphasised that the purpose of the enquiry was not to decide to burn oil at such stations but rather to investigate whether they should be equipped for dual firing so that they could burn oil at short notice should it prove desirable to do so.

The debate that followed the Minister's opening speech covered a wide ground. One of the opponents of the Bill, who was pressing the claims of the roads to a larger capital investment, made great play with the current E.D.A. advertisement. Mr G. Nabarro made his usual attack on electric domestic appliances, arguing that they increased the peak demand for electricity so that relatively old and inefficient power stations had to be brought into operation. Mr A. M. F. Palmer welcomed the decision to set up an enquiry into the working of the B.E.A. and the area boards. On the subject of oil firing, he thought it important to resist the natural bias of operating engineers and designers against oil fuel.

Capital and Fuel Policy

Mr L. W. Joynson-Hicks, Parliamentary Secretary to the Ministry of Fuel and Power, replied to the debate. He said that the relation of investment in the public service industries to total capital investment throughout the country had kept remarkably level. For the electricity supply industry it had varied only between 7·8% and 8·3% from 1949 to 1953 inclusive.

Later in his speech, Mr Joynson-Hicks referred to fuel policy. He suggested that it was wrong to start a national fuel policy by dictating to the housewife whether she could use an electric iron or not, or could use it at a particular time or not, or whether she had to use a gas fire instead of an electric one. The right end at which to start was the production end, where advice and guidance could be more effective. A good deal was being achieved there in the co-ordination of the fuel services.

Faults on a Distribution System —THE COST

By R. S. PEACOCK, B.Sc., A.M.I.E.E.

THE statistics supplied by Mr Smith in his recent article "Faults on a Distribution System" are in general similar to those obtained in the South Western Electricity Board. It seems appropriate to give an account of how an attempt has been made to increase the benefits obtained from such a detailed fault analysis, by carrying on to a further stage whereby the results can be incorporated in the normal economic comparisons which are made in designing electrical power systems.

When the statistics were first collected, soon after 1948, their greatest value lay in the details given in individual reports, whereby "weak spots" in the equipment or design of systems taken over at Vesting Day were shown up. For the next two or three years, efforts were concentrated on obtaining the information in a consistent manner, so that a broad statistical "picture" of the performance of various designs of system and plant could be obtained. It was then realised that bare figures of numbers of faults could not easily be applied directly to system design problems, because any conclusions reached on improved designs could only be applied on the basis of "is it worth spending £x to reduce the fault level by y% ?"

Calculating the Cost

It was obvious that some means must be devised to calculate the cost of system faults. Records had been kept of the duration of faults, the numbers of consumers affected, and the units which would have been supplied to consumers had the faults not occurred. The first approach was, therefore, to evaluate the cost of units lost, using normal tariff figures. The total figure for the majority of faults was, of course, negligible and it was necessary to seek further. A reasonable approach seemed to be to use the cost to the consumer, in labour and materials, whenever supplies were interrupted.

This view was confirmed by a paper read at C.I.G.R.E. during the 1952 session (Paper 329)—"Costs for Disturbances and their Influence on the Design of Power Systems" by S. Lalander and V. Sandström. Lalander and Sandström obtained directly from consumers their estimates of the cost to them of interruptions of supply of varying periods and magnitude. From this they derived a cost per kW for all interruptions of at least three minutes' duration, plus an additional cost per kWh for interruptions of long duration.

This method of assessing the costs was obviously the most accurate, but it was felt that such a survey in this country was not then justified; it was decided that a satisfactory preliminary basis was to calculate the cost of the loss of industrial supplies as being equal to the wages which would be paid to the workers employed for the period of interruption. Published statistics were available for the numbers of industrial workers employed in certain areas, and the average number of units consumed per worker per hour could also be derived. No account was taken of the fact that all the workers would not necessarily be idle for the period of supply interruption, but the error was probably cancelled to some extent by ignoring the cost of overheads which would continue while production actually ceased.

For general loss of supplies to urban areas of mixed industrial, commercial and domestic supplies, the figure was modified by a factor which took account of the proportion of industrial supplies: a similar method was adopted for rural areas. It was decided that the figures given in Table I should be used for the preliminary assessments.

As a yardstick, costs for various types of fault were worked out on this basis, and compared with similar costs obtained by using the figures of Lalander and Sandström. Our results were found to lie within the range of the upper and lower limits of these figures for faults of varying duration, an indication that they were of the right order. Instead of comparing two schemes, or designs, on the basis of capitalised prime cost plus losses, a third factor can now be added to each, namely, the estimated cost of loss of supplies, similarly capitalised. The number of faults expected on the particular system of supply can be obtained from the fault analysis records, the load is known and a figure has been derived (Table I) for the cost of each kWh lost per fault. The method has been applied to diverse problems of which the following are typical:

TABLE I.—BASIS OF ASSESSMENT OF COST OF FAULTS

Type of Supply Interrupted	Cost per kWh lost
Industrial only	£0·2
Mixed (Industrial, commercial, domestic)—Urban areas	£0·08
Mixed (Industrial, commercial, domestic, farm)—Rural areas	£0·04

(*a*) Comparisons of the economics of supply by two methods, where a different proportion of underground cable (as compared with overhead line) is proposed for each scheme. Previously it has not been possible to make an economic comparison of whether the more expensive system using mainly underground cable is justifiable on the basis of an expectation of fewer faults;

(*b*) Lightning Protection—Comparisons of the cost of loss of supplies on different types of construction, and estimates of the capital expenditure permissible for such items as lightning arresters. In these problems the cost of replacing badly damaged expensive equipment, such as transformers, should be included. (Figures for the damage to equipment are normally available from fault records.);

(*c*) Consideration of the relative merits of schemes involving transmission at different voltages, where allowance may now be made for the saving to be expected due to the lower fault incidence on the higher voltage system;

(*d*) Determination of when a duplicate supply is economically justified because of a "need for greater reliability."

In addition, the basic statistics, without calculation of the cost of loss of supplies, have been used for such problems as the assessment of whether the cost of replacing fuses in an oil switch-fuse controlling an overhead line with a high fault level offsets the saving on prime cost compared with a conventional oil circuit-breaker with relay protec-

tion and batteries. The annual costs are capitalised and added to the capital cost of the oil switch-fuse.

Only in (*c*), the problem of comparing systems at different voltages, was the cost of loss of supplies due to faults too small to influence the result appreciably, due to the large difference in capital costs already existing. In the other examples, apart from the satisfaction of having a precise economic comparison for all the factors involved, it was noticeable that the figures used for the cost of loss of supplies affected the results to an appreciable extent, particularly in what would otherwise be borderline comparisons.

Use of Records

The technique is in an elementary stage at present, and while conclusions drawn from statistics of this nature will rightly be subject to the influences of practical personal experience of the problems involved, it is felt that the method represents a step forward in replacing what is often guesswork by a reasonable economic comparison. It is particularly suitable for use on systems in the 6·6 kV to 33 kV range where the fault level may be high. If anything, the indication is that the costs given in Table I are on the low side, particularly for rural supplies, and any comment, or suggestions for an improved method of assessing the basic cost of loss of supplies, would be appreciated.

Although the benefits of detailed fault analysis cannot be obtained in full until records for several years are available, the results so far obtained show sufficiently regular trends to indicate that the figures are reliable enough to use when making economic comparisons.

In order to obtain the greatest benefit, it would be advantageous to "pool" the results from a number of area boards with similar problems. This is now being put into practice, but an earlier attempt to use a standard fault analysis code for all area boards was not completely successful.

It was found that the analysis of, say, the performance of overhead line systems was made in a different manner by various Boards in order to obtain data on the main problems from such different aspects as the following:—(*a*) The behaviour of different makes of similar gear; (*b*) The effect of using different types of line construction; (*c*) Impulse levels; (*d*) Earthing methods.

An attempt to cover too many details and viewpoints in one analysis led to a too complicated and voluminous summary; it was, therefore, decided that for the time being each area board would use its own form of analysis.

It is felt that when sufficient time has elapsed for all the area boards to draw their conclusions on the many problems to be examined, the interchange of views which will follow will fully justify the work involved in obtaining the statistical data.

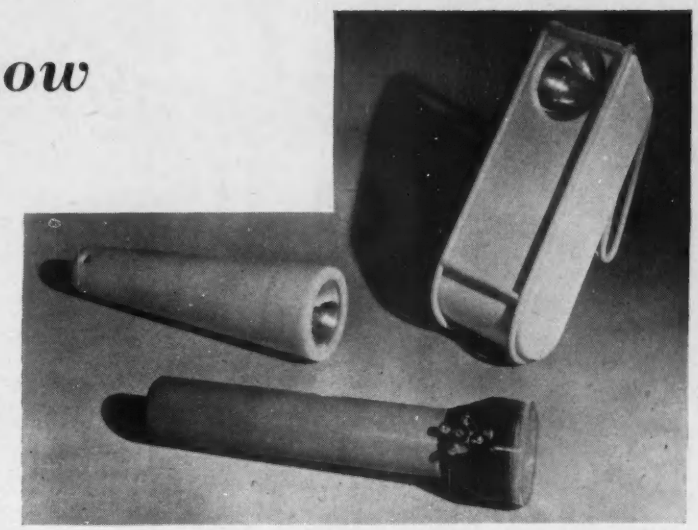
The author would like to express his thanks to Mr G. O. McLean, Chief Engineer, South Western Electricity Board, for permission to publish these notes; any opinions expressed are the personal views of the author.

Piccadilly's Largest Neon Sign

Earlier this month, this "Coca-Cola" neon sign, the largest ever to be erected in Piccadilly Circus, was switched on. Manufactured and erected by Claude-General Neon Lights Ltd., the sign alone weighs 5,000 lbs and is 44 ft square whilst the total weight of the structure amounts to some ten tons. Just under a mile of neon and fluorescent tubing is employed, to give a total electrical loading of 26 kW

Ideas on Show

PRODUCTIVITY EXHIBITION AT OLYMPIA SETS A NEW STYLE IN TRADE DISPLAYS

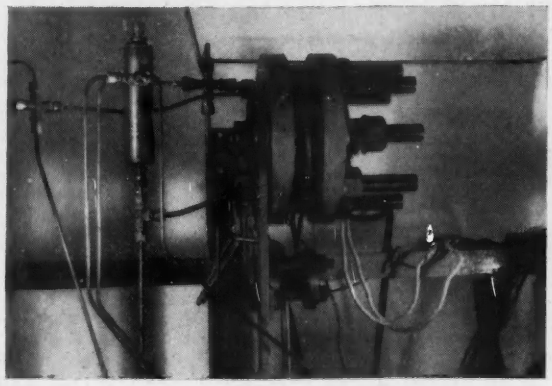


These underwater bodies are in Bakelite polyester resin reinforced with glass fabric

OLYMPIA, during the last seven days, has been the scene of an exhibition, which, unlike the conventional trade show, has been more concerned with "selling" ideas rather than actual products. This unusual display is one of the greatest combined moves made so far to improve industrial productivity and, sponsored by the Institution of Production Engineers, the exhibition revealed methods manufacturers have developed within their own organisations to raise production to a higher level. Apart from industrial concerns, eight Ministries and Government departments, together with the T.U.C. also participated showing new developments, and techniques in a serious attempt to revive the spirit of co-operation in evidence during the war.

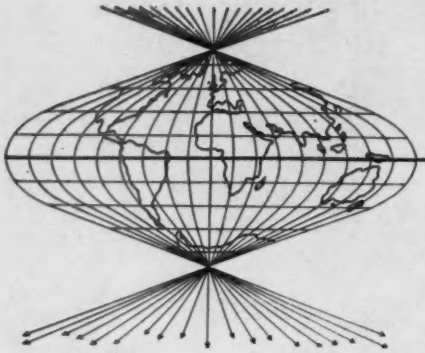
No such exhibition could go far without showing the benefits which accrue from the correct use of electrical energy, and to this end, E.D.A.'s stand provided representative examples for productivity conscious visitors. Demonstrations of induction heating (at mains frequency) for heat treating light alloys, and of dielectric heating for application in the furniture industry indicated but two of the possibilities in the field of materials processing. Inspection was represented by a surface inspection panel which comprises a vertical board on which are drawn a number of intersecting vertical and horizontal lines in black on a white background. The surface to be inspected is laid absolutely flat in front of the panel, any irregularities being shown in the reflection of the lines in the surface. Materials handling was well to the fore in models of various types of conveyor systems, with automatic control of feed, and a battery electric fork lift truck with unit load.

The fuel cell, of which this is a twin unit type (two cells in series) was displayed by the Ministry of Fuel and Power



Of the Ministerial departments, the Ministry of Fuel and Power were emphasising the means developed during the last few years to secure systematic improvement of fuel efficiency in industry. Displays highlighted the work of the National Industrial Fuel Efficiency Service, a feature being a N.I.F.E.S. mobile instrumentation unit, a medium van fitted out with flow meters, multi-point recorders, gauges and the like. Operated by a team of engineers, this instrumentation provides detailed information capable of yielding, on analysis, a complete power and heat survey for an entire factory. Other displays on this stand demonstrated research being undertaken to advance the effective use of conventional fuels and to develop hitherto unexploited sources of energy. In this category were displays featuring the gas turbine, among which was the 1,000 h.p. gas turbine locomotive for which C. A. Parsons and Co. are supplying the turbine unit. There was also the 2 MW "firedamp" gas turbine featured, this being built by the English Electric Co. for operation from the methane-air mixture from the colliery upcast. To complete this display, the fuel cell, in which electrical energy is obtained directly from chemical reaction was shown publicly in operation for the first time. A unit comprising six cells in series was demonstrated providing power for a small fan motor.

Among manufacturers displaying equipment or processes at Olympia were Standard Telephones and Cables Ltd., one exhibit demonstrating the simplicity of a new technique for assembling telephone finger dial plates so that it may now be performed by blind operators. Hoover Ltd. described and illustrated by photographic murals, various techniques used in their factories to attain greater productivity, whilst Bakelite Ltd. showed how the use of their plastic materials could increase productivity of the final product, as in the case of the underwater bodies of electric battery torches. The I.C.I. exhibit featured work study by explaining the techniques of method study and work measurement, with reference to the important subject of incentive schemes. Materials handling equipment was well in evidence, Lansing Bagnall Ltd. and Conveyancer Fork Trucks Ltd. showing the versatility of their electric vehicles.



OVERSEAS NEWS

A SUMMARY OF IMPORTANT EVENTS

CANADA

Orders for Plant

Orders valued at more than $1,600,000 have been placed for British equipment by the Saskatchewan Power Corporation, Mr J. W. Tomlinson, the general manager of the Corporation, has announced. He said the Corporation had ordered a 33,000 kW turbo-generator for the Saskatoon power station from C. A. Parsons and Co., Ltd., and a tentative order for a similar generator had been placed with Metropolitan-Vickers Electrical Co., Ltd., for the Estevan power station in south-eastern Saskatchewan. The Corporation's Estevan power station was recently augmented by a 20 MW set, and now has a capacity of 40 MW. It burns lignite from Bienfait. The present station at Saskatoon has a capacity of 47,000 kW. The plant is owned by the Power Corporation but energy is sold in bulk to the municipally-owned distribution undertaking under a 25-year agreement which expires this year. A one-year extension of the agreement has been made while negotiations for a new deal continue. It is the aim of the Power Corporation to integrate the major power stations into a province-wide power pool linked by grid transmission lines. Two hydro-electric projects are also envisaged.

The Nova Scotia Light and Power Co. has placed an order with the English Electric Co., for a 45,000 kW steam turbo-alternator with condensing plant. Value of the contract is put at $7 millions. It is understood that this new set is for the Nova Scotia Co.'s Water Street power station. It is scheduled to be operating in 1957.

Water Power Development

Hearings are shortly to be held into the renewed American application to the International Joint Commission for authority to dam the Kootenay River near Libby, Montana, for power purposes. This seems likely to bring to a head the whole question of power development in the Columbia River basin. So far, plans have been put forward from both Canadian and American organisations. The U.S. plan suggests a dam to prevent the Kootenay River from flowing north into the Columbia. There would be a dam at Bull River, which would provide 68 MW for Canada, the Libby Dam to give the U.S. 600 MW, plus a possible further 90 MW to Canada, and an increase of 800 MW at Grand Coulee and other dams. But the Canadian proposals, which would leave Libby high and dry, suggest a dam at Bull River to turn the water flow north to Luxor dam site and into the Columbia system, with dams at Kitchen Rapids, (110 ft head), Mica Creek (467 ft head), Death and Priest and Little Dalles Rapids. In addition, U.S. power plants on the Columbia River would benefit up to 10 million kW annually. With such vast resources available for development, it is evident that there will be a lengthy discussion before any plans are accepted from either side.

H.-E. Investigation

To placate certain local fears, the Quebec Hydro-Electric Commission is launching an investigation to obtain additional information about the effect of the proposed power development in the Montreal region before taking a decision regarding the utilisation of the waters of the St. Lawrence River and Lachine Canal for hydro-electric purposes. Apparently certain experts have claimed that it would be better and less costly for the proposed power development to be located at the foot of the Lachine Falls rather than near Victoria Bridge, a site recommended by other engineers. It seems that there is some fear locally that if the present plans were followed, Montreal, its suburbs, and south shore communities, might be greatly inconvenienced.

More Power

Additional survey work by field crews of Quebec Metallurgical Industries and its associated companies in the Northern B.C.-Yukon watershed have indicated that a further 560,000 h.p. could be developed, in addition to the original estimate of 4·3 million h.p. The additional hydro power capacity would be created through the damming of the Taku River near its junction with the Inklin River. Previous plans also called for diversion of the Upper Yukon, Dezadeash and Salmon Rivers into the Taku, but official authorisation is still awaited from the Federal and provincial governments.

SWEDEN

Another Station

An order has been placed with Asea, of Sweden, for the supply of two 150,000 kVA generators for the Stornorrfors hydro-electric station by the Swedish Power and Water Board. This station is one of a number of new projects which have been in the planning stage for some little time.

EUROPE

Portuguese Development

A new Portuguese company, the Hydro-Electrica do Douro, has just been authorised by the Government to develop hydro-electric power schemes along the Douro River in North Portugal. The state has subscribed half the total capital. The company is to make a general plan of the work which is to cover the Douro River and all its tributaries. The first project, which is the most important, has already been planned. It involves building a hydro-electric plant at Picote on the part of the Douro River which forms the frontier between Portugal and Spain. It will be the largest single source of power in Portugal and will have an estimated capacity of 2,500 million kW a year. Work is to begin within six months and should be completed in four and a half years. The total is estimated at about 500 million escudos.

Austria's Expansion

Production of hydro-electric power in Austria this year has considerably increased, and will be raised still further by the commissioning last month of the new power station on the River Inn at Braunau-Simbach on the Austro-Bavaria border. Total hydro-electric output of Austria in April was 419 million units, compared with 337 million in March. The current power development programme provides for the installation of a further 89·5 MW of generating plant this year. Last year new plant installed totalled 118·7 MW.

Contract Transfer?

Although the American concern, Thompson-Starrett, were awarded the contract for the construction of the Megdova hydro-electric project in Thessaly, by the Greek Government, (ELECTRICAL TIMES, 29 Apl), the guarantees of capital demanded by that firm have not yet been forthcoming. The Greek Minister of Co-ordination has now approached the French Company, Omnium-Lyonnais, to see if they will undertake the scheme. Any agreement

reached with that concern would be subject to the approval of the French Government who have already agreed, under the terms of the Franco-Greek Economic Agreement, to guarantee the financing of the project.

TURKEY

Another Plan

In Turkey there are numerous plans involving power supply. The latest of which we have news is a plan, under consideration by the Electricity Planning Department of the Ministry of Works, for the construction of a hydro-electric project in the Van province, in order to supply a cement plant which is to be built in the near future, and also the towns of Ercis and Muradiye. At the outset the plant would have an output of 9 million units, it is stated.

AFRICA

A New Station?

Although Cape Town City Council has not committed itself to a definite period for the erection of a further power station the necessary steps are being taken to avoid undue delay with the scheme when a final decision is reached. The city electrical engineer, Mr C. G. Downie, has already investigated the question of a suitable site for the new station and the Electricity Committee will shortly submit a report on this aspect of the matter. Meantime, the City Council has authorised the appointment of Messrs Merz & McLellan as consulting engineers for the purposes of the scheme. It may be recalled that as the "pooling" arrangement with Escom comes to an end in 1957 and as the latter has intimated that it will not renew the agreement, the City Council last December decided to retain its independence in the generation and distribution of electricity and agreed in principle to the building of a further power station.

For the supply and erection of a tenth boiler at the Table Bay power station the Cape Town City Council has now accepted the tender of Babcock and Wilcox Ltd at a price of £378,278. This new unit forms part of the 1944 extensions to the station.

S.W. ASIA

Another Scheme

The Madhya Pradesh Electricity Board has prepared a scheme for the supply of electricity to the towns of Narsinghpur and Kareli. The cost of the scheme, which will be completed in 10 years, is estimated at Rs. 4,43,000. The establishment of a temporary diesel-power station either at Narsinghpur or Kareli, the erection of substations and the laying of distribution mains at both the towns are contemplated under the scheme. According to the scheme, electricity will be supplied to these towns on a permanent basis by the power-house to be constructed at Itarsi under the Hoshangabad Electricity Scheme.

Power Supply Statistics

The aggregate installed capacity of generated plant in India at the end of December 1952 was 2,062 MW, according to the annual review covering the year 1952, published by the Central Water and Power Commission. The review covers 615 undertakings, of which 424 had their own generating facilities. Of the latter figure, 220 were company undertakings with a total of 1,179 MW of generating capacity; 190 were government undertakings with 857,545 kW of plant, while 14 municipalities providing the other 25,191 kW. Steam generating plant constituted about 57% of the total installed capacity, and hydro plant a further 34·7%. The average load factor in 1952 for all steam power stations was 52·4%. According to the report, the total number of consumers in India at the end of 1952 was about 1,842,000, having increased by 165,668 or 9·87% during the year. The average annual domestic consumption amounted to 436 units, compared with 455 units in 1951, but that figure is probably higher than the actual average consumption, for the major portion of the total domestic consumption is accounted for by a few large cities in which residential buildings consisting of many flats or apartments are treated as a single consumer for accounting purposes. Industrial establishments purchased about 3,207 million units from public electric utilities during the year.

Hydro Scheme Inaugurated

The Bhakra-Nangal irrigation and power project on the River Sutlej was officially inaugurated by Mr Nehru, the Indian Prime Minister, last Thursday. Although primarily providing irrigation for a large area, the project includes the Ganguwal power station which is to have a capacity of 48,000 kW, made up of two generators, both of which are already at the site. The main canal is some 670 miles in length. This power house will utilise water from the River Sutlej via the Nangal canal. There is still disagreement, however, between India and Pakistan regarding the use of the Sutlej River (part of which runs through Pakistan). The Indian Government maintains that the scheme will use only the monsoon surplus which previously was wasted. The matter is likely to be referred to the United Nations for arbitration.

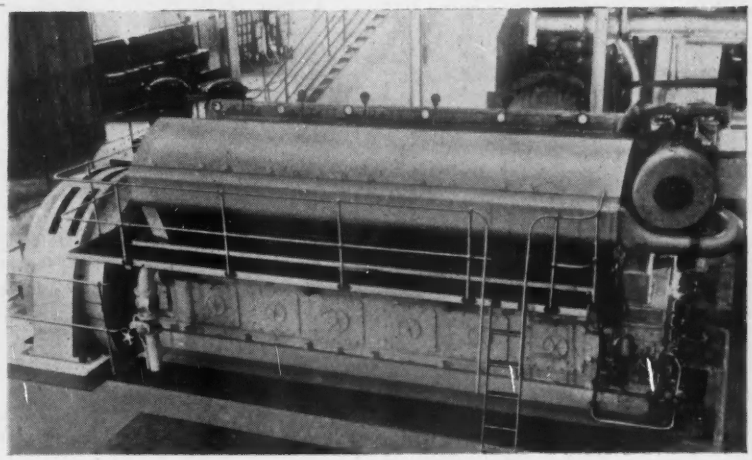
AUSTRALIA

Plant for Tasmania

With work well under way on the Trevallyn hydro-electric scheme for the Hydro-Electric Commission of Tasmania, we now have news that most of the machinery has arrived in the island. The four 28,000 h.p. turbines and two of the 25,000 kVA alternators have been supplied by the English Electric Co., Ltd., while the other two 25,000 kVA alternators are being provided by a Swedish manufacturer.

Port Augusta Opening

Arrangements have been made by the Electricity Trust of South Australia for the official opening of the Port Augusta power station by the Governor, Sir Robert George, on 23 July, when the first of three 30,000 kW turbo-alternators will be put into operation. The second machine is expected to be in commission later this year.



Now relieving the critical power situation in Lagos is this 1,250 kW diesel generator which was recently put into commission at the Ijora "A" power station of the Electricity Corporation of Nigeria, where three turbo-alternators of a total capacity of 13,750 kW are also installed. Comprising a 12-cylinder Mirrlees pressure-charged engine running at 375 r.p.m., and having a continuous site rating of 1,800 b.h.p., direct coupled to a Brush alternator, this set has been generating power at approximately 1d p.u., using gas oil at 1/5d per gallon. A second set is in course of erection. Incidentally, the temperature in the station is around 105° F., humidity being in the region of 95%. A closed system is employed for water-cooling the engines, a 2,000 gallon fresh water tank feeding both engines. Sea water is the coolant medium in the engine jacket. The next stage in Nigeria will be the commissioning of Ijora "B" power station in which two Brush Ljungstrom 12,500 kW steam turbo-alternators are to be installed. It is doubtful if the first of these sets will be operating before the end of this year

Personalities IN THE INDUSTRY

Mr G. F. Archer, A.M.I.MECH.E., has been appointed education and training officer to the Merseyside and North Wales Electricity Board, and will take up his duties on 3 Aug. next. He succeeds **Mr L. C. Jarman,** A.M.I.E.E., A.M.I.PROD.E., who is now with British Metal Industries Ltd. At present Mr Archer is in charge of apprenticeship training with Electro Hydraulics and Rubery Owen Ltd. Prior to that he was education officer with A. V. Roe, Ltd., at Manchester, and had previously been associated with the Percival Aircraft Co, and the British Motor Boat Co.

In recognition of his valuable efforts on behalf of the St. Lawrence power project, **Mr R. H. Saunders,** chairman of the Hydro Electric Power Commission of Ontario, is to be the guest of honour at a testimonial dinner later this month sponsored by the Ontario Municipal Electrical Association. The suggestion is now being made that the new power development should be known as the "Robert H. Saunders-St. Lawrence Generating Station."

Ekco-Ensign Electric Ltd. announce the appointment of **Mr J. A. Hatto** as their representative covering the county of Derbyshire and part of Nottinghamshire. He will operate from the Company's East Midlands sales office at 57, Hounds Gate, Nottingham.

Mr F. B. Holt, M.I.E.E., local director, Higgs Motors Ltd, is to visit Canada in the late summer we hear. During his stay he intends visiting existing agents and customers, but Mr Holt is mainly interested in trying to contact as many new potential customers as possible, and will also be on the lookout for an opportunity to develop new agencies in parts of the Dominion, which hitherto have not been covered. Anyone wishing to contact Mr Holt can do so through the head office of the company, or the U.K. Trade Commissioners in Canada.

Mr W. G. Appleyard announces that he is resigning his post of publicity manager to Midland Electric Manufacturing Co., Ltd., of Birmingham, on 31 July next. Mr Appleyard has been with M.E.M. since 1936 and his services are being retained by that company in a consultative capacity. He will subsequently operate as a sales consultant with offices at 21 Steelhouse Lane, Birmingham. He is a Council member and past chairman of the Birmingham Publicity Association of which he is a founder member.

The Minister of Fuel and Power has appointed **Major R. L. G. Milburn,** of Longframlington, as a member of the North Eastern Electricity Consultative Council. **Major C. L. Baldwin,** M.C., J.P., **Alderman C. B. Chartres,** C.B.E., M.I.E.E., and **Councillor H. French,** M.B.E., have retired from the Council.

Mr W. Haynes and **Mr E. W. Spalding** have retired from the board of Ruston and Hornsby Ltd.

Mr A. W. Page, M.B.E., T.D., M.I.P.E., has been appointed London manager of the Igranic Electric Co., Ltd., in place of **Mr N. V. Baldwin,** T.D., M.I.E.E., who is now on his way to Johannesburg to take up his appointment as managing director of Brookhirst-Igranic S.A. (Pty) Ltd., Metal Industries' Electrical Division South African subsidiary company. At a farewell luncheon recently, **Mr R. L. Paice,** M.I.P.E., sales director of the Igranic company, presented Mr Baldwin with a silver cigarette box, engraved with facsimile signatures of friends and colleagues. Mr A. W. Page, who represented the Igranic Electric Co. at Newcastle-on-Tyne prior to the war, served with Tyne Electrical engineers, R.E., and saw service in India, Middle East, Italy and Germany, attaining the rank of Lieut.-Colonel. His post-war service with Igranic has been as production engineer and, latterly, as deputy London manager.

Mr A. W. Howard, general manager of Calgary Power Ltd., has been elected president of the Canadian Electrical Association. The new vice-presidents are **Mr J. C. Dale,** of Canadian Utilities Ltd., **Mr V. A. Ainsworth,** of Newfoundland Power and Light Co. and **Mr J. A. Page,** of Southern Canada Power.

Mr H. Cobden Turner has been appointed a director and the vice-chairman of Harrison McGregor and Guest Ltd., agricultural implement manufacturers.

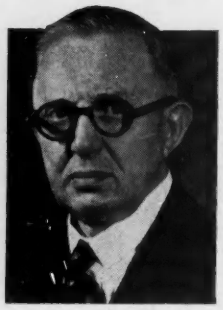
Mr F. H. S. Brown, B.SC., (HONS.), M.I.MECH.E., M.I.E.E., deputy generation design engineer at the headquarters of the British Electricity Authority, has been appointed generation design engineer. He succeeds **Mr F. Shakeshaft,** O.B.E., A.M.I.E.E., M.INST.F., who is to concentrate on future and special generation design problems without responsibility for the day-to-day work of the Generation Design Branch. Mr Brown, after serving an apprenticeship with the Corporation of Birmingham Electricity Supply Department, spent several years operating power stations in various shift capacities and was then engaged for a couple of years as a technical engineer in the construction department on design work in connection with the Hams Hall B power station. He served later as boiler house superintendent successively at the Nechells (Princes) and Hams Hall "A" stations before becoming assistant construction engineer of the West Midlands J.E.A. and, later, chief technical engineer of the Liverpool Corporation Electricity Supply Dept. On the establishment of the B.E.A. in 1948, Mr Brown joined the Merseyside and North Wales Division, of which for two years he was chief generation engineer (construction), before transferring to headquarters in 1951. Mr Shakeshaft, who was educated at the Technical College, Preston, served first with a firm of engine, boiler and general engineers and then as turbine designer

Mr F. B. Holt

Mr W. G. Appleyard

Mr A. W. Page

Mr F. H. S. Brown



Mr F. Shakeshaft

and power station specialist with the Dick Kerr Co., and the English Electric Co., Ltd. In 1930 he joined the Central Electricity Board as assistant engineer (supply) and later became the Board's power station development engineer until, in 1948, he received his appointment as generation design engineer with the Authority.

British Insulated Callender's Cables Ltd. announce that **Mr W. G. Dumville,** M.C., T.D., has been appointed regional manager, North East, to succeed **Mr E. Charlton** who is retiring. Mr Dumville has a distinguished war record. Wounded at Dunkirk, he was awarded the Military Cross and completed his service as lieutenant-colonel commanding the 4th Battalion of the Green Howards. Until his appointment, he was an assistant sales manager with B.I.C.C., being responsible for wire mill products and moulding machines.

Manager of the Worcester and Malvern district of the Midlands Electricity Board since 1948, **Mr H. F. Hudson,** M.I.E.E., has been appointed to the staff of the Worcester and District sub-area headquarters. His successor as district manager at Worcester and Malvern is **Mr E. C. Watson,** ASSOC. I.E.E., who previously held a similar post at the Board's Kidderminster district. A native of Burnley, Mr Hudson served a works apprenticeship and had subsequent training with Ferranti Ltd. and Chamberlain and Hookham Ltd. Subsequently he held positions with the Rawtenstall Electricity Supply Department and in the Bradford electricity undertaking. He joined the Worcester undertaking in 1928 as testing superintendent, being senior assistant electrical engineer there prior to vesting day. Mr E. C. Watson held various appointments with the Shropshire, Worcestershire and Staffordshire Electric Power Co. from 1930 onwards, and when the Supply Industry was nationalised in 1948 was district manager at Bromsgrove. Since August 1948 he has been district manager at Kidderminster.

Mr K. D. Hodgson, A.M.I.E.E., whose appointment with the Bermuda Electric Light Co. we referred to on 1 July, has joined that concern as distribution engineer, we are now informed, and not as was stated.

The University of Liverpool has conferred the honorary degree of Master of Engineering upon **Mr A. R. Cooper,** M.I.E.E., M.INST.F., controller of the North West, Merseyside and North Wales Division of the B.E.A. Our accompanying photograph was taken by the *Liverpool Daily Post* at the ceremony when tribute was paid not only to his engineering ability but his wide interest in other social matters, particularly his valuable invention which permits communication with persons who are both blind and deaf.

Mr A. R. Cooper, right, receives his degree, and congratulations

Nominated as chairman of the independent committee which is to enquire into "the organisation and efficiency of the electricity supply industry in England and Wales" (see page 86) is **Sir Edwin Herbert,** LL.B., whose photograph we reproduce below. Sir Edwin is senior partner in the firm of Sydney Morse and Co., solicitors, a director of about fourteen companies, including Broadcast Relay Service Ltd., and is a member of the Council of the Law Society. Among the other members of the committee are **Professor Ronald S. Edwards,** who served on the Clow Committee on the peak load problem nearly six years ago, and **Mr Lawrence Robson,** who is chairman of Associated British Engineering Ltd.

The officer-in-charge of the Control Mechanisms and Electronics Division of the National Physical Laboratory is **Mr R. H. Tizard,** B.A., A.M.I.E.E., as we note on page 98, this new Division has been formed by the amalgamation of the former Electronics and the Control Mechanisms sections of the N.P.L.

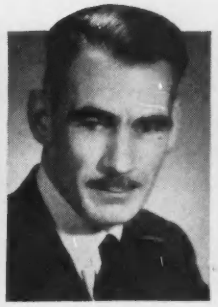
Appointed as nuclear power engineer to the British Electricity Authority is **Mr J. C. Duckworth,** B.A., chief engineer of the Ferranti Laboratories, Wythenshaw. He will organise and lead a new branch of the B.E.A.'s Chief Engineer's Department, which will be engaged on the design, construction and operation of nuclear power stations. Mr Duckworth, who received his early education at King's College School, Wimbledon, gained an exhibition for Magdalen College, Oxford, where, in the Mathematical Moderations examination, he got a First Class Honours in physics. His subsequent studies on nuclear physics for the PH.D. degree were interrupted by the war and, in 1939, he joined the Telecommunications Research Establishment, in charge of the division engaged on the design of ground radar stations for the R.A.F. In 1946, he joined the staff of the Chalk River project in Ontario and worked there on nuclear physics and the design of nuclear reactors. Returning to this country in 1947, Mr Duckworth went to the Atomic Energy Research Establishment at Harwell, where he supervised a group working on neutron spectroscopy involving measurements work concerning nuclear reactors. He took up his present post at the Ferranti Laboratories early in 1950.

The General Electric Co., Ltd., announces the following appointments: **Mr J. B. Taylor,** T.D., manager of Leicester branch to be managing director of the British General Electric Co. (Canadian) Ltd.; **Mr J. S. Langlands,** managing director, British General Electric (Canadian) Ltd., to be district assistant manager, G.E.C. Scotland; and **Mr K. L. V. Nichols,** of Ipswich branch, to be manager of G.E.C. Leicester branch. Mr J. B. Taylor joined the G.E.C. in 1936 and for the past five years has been manager of the Company's Leicester branch. During this period new premises were established in the centre of Leicester with greatly increased facilities. Mr Taylor has been the Secretary of the Leicestershire branch of the E.I.B.A. and in addition

Mr W. G. Dumville

Mr H. F. Hudson

Sir Edwin Herbert



Mr J. B. Taylor

Mr K. L. V. Nichols

has served on the committees of various other electrical associations. Mr K. L. V. Nichols joined the General Electric Co., Ltd., in November 1928 as a trainee at Head Office and, in 1934, was appointed to the company's Ipswich branch. After war service, he resumed his duties in Suffolk and, upon the nationalisation of the Supply Industry, was appointed liaison officer to the Eastern Electricity Board. Later, in 1951, he was appointed G.E.C. sales supervisor for the Eastern Counties. Mr Nichols was chairman of the Ipswich and District Electrical Association in 1947, and up to the time of his Leicester appointment, chairman of the Suffolk branch of the E.I.B.A.

The application by British industry of results of research from the National Physical Laboratory is fostered by direct contact between the research workers at the Laboratory and individuals in industry, as well as by contributions to the scientific and technical press. It is, however, felt that much more could be done in the way of bridging the gap between the research laboratory and industry. To meet this need, Sir Edward Bullard, F.R.S., Director of the National Physical Laboratory, has appointed **Mr E. I. Brimelow,** M.ENG., A.I.M., and **Mr A. J. Garratt,** M.B.E., B.SC., A.INST.P., as liaison officers to work with industry. A physicist, Mr Garratt was in the Civil Service from 1940 until 1951, first with the Ministry of Supply, Armament Research Establishment and later with the Festival of Britain office as staff physicist. More recently he has held an appointment in industry and is a scientific adviser to the B.B.C. Television Service. Mr E. I. Brimelow is a metallurgical engineer. He was for eight years from 1936 engaged in research at the Royal Aircraft Establishment, Farnborough, on materials for use in aircraft. After two years in industry as a metallurgist, and research, and development manager, he joined in 1949 the Chief Scientific Adviser's Division of the Ministry of Works, where he remained until transferred to the Building Research Station, D.S.I.R., in 1950. He has also served on various technical committees of the B.S.I. and on Advisory Committees of the Ministry of Supply.

Appointed as Commercial Manager of Marconi Instruments Ltd. is **Mr F. G. Cook.** For some years Mr Cook has been developing the firm's export business in his role as manager of the Instrumentation Export Division of Marconi's Wireless Telegraph Co., Ltd., managing agents in export for Marconi Instruments Ltd.

After gaining considerable engineering experience in the instrumentation field, Mr Cook joined the Instrument Company on its formation in 1936. He occupied in turn the positions of sales manager, sales and contracts manager and assistant general manager, before undertaking the task of developing the firm's post-war export trade as manager of the Instrumentation Export Division. He has travelled extensively on behalf of the company, studying market conditions at first hand. Recently, he spent some time in Canada and the U.S.A.

Mr Gordon McKenzie has been appointed display and exhibition manager to Hoover Ltd. Born in London in 1913, and trained as an electrical engineer, Mr McKenzie was, before the war, on the sales promotion side of the Croydon and Battersea electricity undertakings and the North Metropolitan Electric Power Supply Co. After war-time service as a major with the Royal Artillery, Mr McKenzie worked with the Croydon electricity supply undertaking and later set up and managed the display and exhibition department for the London and Home Counties Joint Electricity Authority. On nationalisation, this department was expanded under Mr McKenzie's management to meet the needs of the South Eastern Electricity Board.

Mr B. S. Quirk has been elected a director of Kalgoorlie Electric Power and Lighting Co.

OBITUARY

Mr A. R. Heath, formerly a director of S. Guiterman and Co., Ltd., died on 6 July.

Mr G. C. Paul, who started the business of Electromode Domestic Appliance Co., Ltd., about three years ago, died recently, aged 26.

NEW LITERATURE

Garcke's Manual of Electricity Supply

HERE is the fifty-first edition of that ever-useful compendium ready to take its place on the reference shelf. There is little change in this edition—an indication that most of the worthwhile information has an appointed place, but, of course, the data has been brought up to date. For those unacquainted with the volume, we should add that within its 900 pages is compressed a wealth of detail chiefly concerning the Electricity Supply Industry in Britain—particulars being given of power station plant, operating data for the past five years, and similar information. The major part of the volume is devoted to the B.E.A., segregated into the Divisions and Area Boards, details of each district being listed. There follows a section giving financial and other information relating to many electrical manufacturers, a list of associations, and a directory of personnel. The volume is strongly bound to withstand the frequent usage which it will undoubtedly get. Published by Electrical Press Ltd., 900 pages, 8¼ in. by 5½ in. Price £3. 17s. 6d.

Basic Principles in Electrical Engineering

by I. H. Child.

THERE exist, in electrical engineering technology—as in many other subjects—certain "blind spots" which give trouble both to graduates and to practising technologists. These troubles are usually due to a lack of perception of the connection between fundamentals and their practical application. In his book Mr Child has gathered together a series of articles which were written for a house-journal in an endeavour to clear up many of the points which he found caused confusion. The volume cannot therefore be regarded as a textbook, but is rather an adjunct which can be most usefully employed when revision classes are undertaken. Published by E. and F. N. Spon Ltd., 172 pp, 4½ in. by 7¼ in. Price 12s. 6d.

Electrical Installation Work

by T. G. Francis.

FIRST published in 1949, this book has now come into its second edition. It was primarily written for those engaged in electrical installation work who were desirous of obtaining further knowledge of the technical side of their occupation. Opportunity has been taken in this latest edition to include references to the Twelfth Edition of the I.E.E. Regulations. The text covers supply systems, consumer's circuits, conductors and cables, wiring systems and accessories, earthing testing, instruments and measurement, illumination, electric heating, d.c. and a.c. machines, and finally electric cells and electric bells. The last chapter is devoted to simple internal telephone circuits. Published by Longmans Green and Co., 256 pp, 5½ in. by 8½ in. Price 12s. 6d.

BOOKS RECEIVED

Silicones and their Uses, by R. R. McGregor. Outlines history, chemistry and commercial development, production and application of silicones. Published by McGraw-Hill, 302 pages, 9 in. by 6 in. Price 42s. 6d.

The Hammer and the Anvil, by J. F. Riley. Brief sketch of the background of Michael Faraday. Published by the Dalesman Publishing Co., Clapham, via Lancaster, Yorkshire, 40 pages, 8½ in. by 5½ in. Price 4s. 6d.

Dynamo and Electric Motor Building, edited by E. T. Lawson Helme. One of publisher's work handbooks completely revised by the editor. Third edition, published by Cassell and Co., 172 pages, 7¼ in. by 4¼ in. Price 4s. 6d.

Electric Commercial Catering Handbook. Guide to the design, installation and maintenance of commercial catering equipment. Published by the British Electrical Development Association, 2 Savoy Hill, W.C.2, 66 pages, 7 in. by 4½ in. Price 5s.

Electricity on the Farm. Revision of an earlier edition, covers all aspects of farm electrification for both actual and prospective consumers. Second edition, published by the British Electrical Development Association, 2 Savoy Hill, W.C.2, 100 pages, 8½ in. by 5½ in. Gratis.

PROBLEMS AND PRACTICE

In Engineering

Every engineer has a story to tell; why not tell yours on this page? We welcome contributions to this feature, and those published will be paid for at our standard rates. Problems which are encountered and overcome in day-to-day maintenance or installation of electrical plant; useful methods and techniques developed for specific jobs, or current practices, all make instructive reading for others. We will also consider for publication problems requiring an answer. Sketches are often helpful and need only be rough, as they will be redrawn before use.

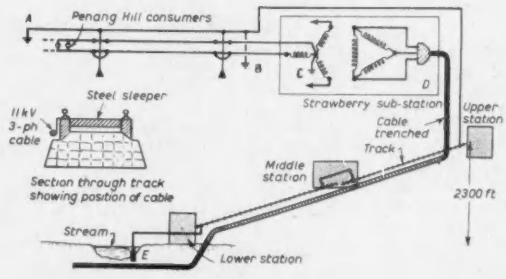
Lightning Damage

WHEN the a.c. supply was extended to Penang Hill (Malaya) about 1923, the l.t. supply, taken from a delta/star transformer at the Strawberry substation at the top of the hill, was connected to a number of bungalows and a hotel by bare copper wire strung on wooden poles. An earth wire was run along the top of the poles, earthed at its extremities (A and B in the diagram) and near the bases of a spaced number of poles en route. At the substation both the star point of the l.t. winding and the incoming h.t. cable sheath were earthed (C, D).

However, following nearly every heavy thunderstorm a large number of the lamps were burnt out, and no improvement was obtained when larger, more numerous and deeper earth plates were connected. As Penang Hill is 2,300 ft above sea level and practically all rock, it was considered that the top strata of soil formed one plate of a capacitor in relation to the sea as the other layer, high voltages being thereby induced. The soil on the top of the hill, largely decayed vegetation, surmounting a layer of red clay (decayed granite) and conductivity was unlikely to extend deeply beyond the top layer. This may also have accounted for an indifferent conductivity between A, B, C and D, although there is a mysterious factor in that these earths should have formed a circuit to earth at sea level via the cable sheath to the point E. The cable was trenched only where it is shown solid, the remainder being clipped, over the serving of course, alongside the rail track but insulated from earth as shown in the inset sketch. The lamps were subjected to a high voltage as evidence by the blackening of the bulbs and it can only be assumed that high voltages were induced on the wiring during the storms.

To overcome the difficulty the earthing system was connected to the rails of the Penang Hill railway, which is in two separate sections. The sections were bonded together and the lower end connected to an earth plate sunk in the bed of a stream. There was no further trouble after this. By earthing the rails, two birds were killed with one stone, as the rails were laid on solid rock and concrete viaducts and previous to the earthing considerable trouble had been experienced with the railway signalling system.—*K. Coombs.*

Diagram of the supply system for Penang Hill, showing routing of the cable



Gas Pipe Earthing

RECENT letters on this subject were very interesting to me because of an experience of mine a few years ago. I had been concerned with an electrical installation on a new housing site, and a gas pipe burst into flame in one of the houses soon after the tenant moved in. No gas or electricity was being consumed at the time, though the housewife was in and averted a serious fire. The pipe feeding a gas cooker was in contact with water pipes and had punctured in several places. No fault was found in the electrical systems of this house or those of the neighbours on either side but an earth test showed the resistance of the gas main as 0·2 ohms and that of the water main 0·4 ohms.

Old houses with water and gas pipes in contact all over the place are indeed a headache. I feel tempted to bond where the resistance between is less than 1 ohm, and am always glad to know what others think is the best way to deal with this problem.—*S. R. Pratt.*

THE present discussion in Problems and Practice on the above subject raised by Mr Westlake's experience is most interesting but his query as to "what tests can be made to indicate this state of affairs" has not yet been answered, so may I suggest that the articles "Earthing in Practice" by F. H. Mann, published in the 18 Mar. and 8 Apr. issues, will provide the required information.

In Mr Westlake's notes he states the "installation was tested including earth resistance tests, but everything was satisfactory," but fails to give details of the nature of the tests and particularly the earth fault current path or in other words the earth loop impedance. This test is the most essential one when checking the efficiency of the earth protecting system and I am sure had it been made it would have revealed a condition far from satisfactory.

With regards to adequate spacing between electrical conduits and gas pipes there are often instances where this may be impossible and bonding then appears to me reasonable in order to eliminate fortuitous contact, provided that the electrical system earthing is efficient and better still subject to testing at regular intervals.—*T. H. Snelson.*

Overwinding Crane

SOME time ago, in the machine shop of a small foundry, an unusual fault was occurring at intervals. Two small overhead travelling cranes operated from floor level by suspended push button units served the shop for all major hoisting operations. Although provided with a limit switch one of these hoists frequently overwound and unless the operator was in a position to dash for the trolley wire isolating switch, considerable expense was caused by lost production and fitters' time in stripping down the winding gear.

A visual and instrument check of all wiring and connections showed them to be satisfactory—as had been found by previous electricians. A trial run was arranged with an apprentice standing by the isolating switch. This showed that the limit switch was actually operating with the normal spark to be expected when breaking circuit.

For this test all covers had been removed and it was noticed that the reversing contactor which controlled the motor was still in the "hoist" position. When this had been released by hand and checked once again for freedom of movement and lubrication, it was concluded that the fault must be due to residual magnetism in the iron core—an unexpected reason since the supply was a.c. and the contactor manufactured by a reputable firm. The limit switch, of course, operating in the coil circuit, was ineffective.

Since a long delivery time was quoted for spares, the contactor was dismantled and a hole drilled and tapped 4 B.A. in the face of each limb of the moving core. Into these holes brass screws were driven and filed down to give an effect somewhat like that of the cut-out on a motor car. When put into operation again no undue noise was noticed and satisfactory service was still being given when the writer left the district.—*J. G. Potter.*

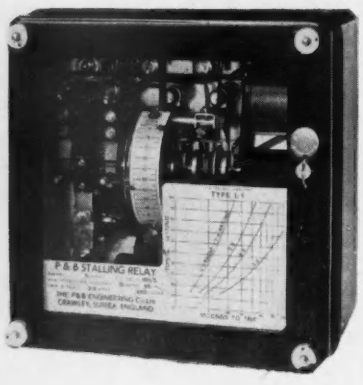
Equipment for Industry

New Motor Protective Relay

THE disadvantage of the usual form of protection employed on induction motors is that if the motor stalls or fails to start first time, the motor windings may be damaged or destroyed by indiscriminate attempts to restart. The P & B ENGINEERING CO., LTD., Crompton Way, Crawley, Sussex, have added a new relay to their range which sets out to eliminate this source of worry. The relay comprises basically two elements, a contactor and a thermal device. The contactor is arranged to close when the current taken by the motor rises to 3 times the normal value, but an adjustment is provided whereby this value may be set anywhere between 2½ and 7, and whatever the setting it is expected to be below the starting or stalling value of motor current. When the relay contactor closes under overload, the short circuit across the thermal element is removed, and as the temperature rises in the bimetal strip spirals, which comprise the thermal element, a pair of contacts close, tripping out the motor.

Different types of relays have been produced, operating from 1 amp or 5 amp secondaries of a current transformer, or direct on a circuit of up to 60 amps. These variations may be applied to either the two basic types manufactured. One caters for motors taking up to 40 seconds to reach full speed and the other for motors taking greater than 40 seconds. The relay thermal element has an inverse time current characteristic. A time setting adjustment is fitted on the relay and times of operation between 5 and 180 seconds are available.

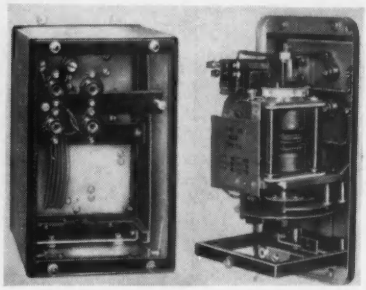
P & B's new stalling relay affords protection to stalled motors



In addition to the basic unit, certain extras are obtainable. These include a flag indicator, indicating lamps, auxiliary switches and an auxiliary contactor. This second contactor allows for two attempts to be made at starting the motor after its having stalled. If the motor does not start after the second attempt, the contactor latches in and prevents further closing until a push-button is reset.

Withdrawable Element Flush Relays

THERE is no doubt that relays with flush pattern cases have a more pleasing appearance than those with projecting pattern equipment, and are, of course, well in keeping with the "streamline" appearance of modern switchgear. However, projecting pattern types are usually preferred for their greater accessibility to the relay movement for maintenance. A new design of relay case combining both features is, however, now made by A. REYROLLE & CO., LTD, Hebburn, Co. Durham. It is a withdrawable flush-pattern type, appearing, under normal service conditions, as a conventional flush relay case. On removal of the front cover however, the relay movement may be withdrawn on a captive carriage to the position shown in the left hand illustration where the relay movement is readily accessible. All electrical connections to the movement are maintained in the withdrawn position by means of flexible connectors. Available in s.p. and horizontal t.p. relay arrangements, the withdrawable principle may be applied to most types of standard Reyrolle relays.



This Reyrolle relay case provides flush relays which are withdrawable

Oil Switch to Draft Standard

TO increase the degree of safety afforded to the operator of an isolating switch a new Draft British Standard CR (ELE)2032 has been produced requiring that oil-switches should be capable of being made on to a fault in addition to the usual interruption of short-circuit current. A new oil-switch, which complies with the specification, produced by the General Electric Co., Ltd, Magnet Hse, Kingsway, W.C.2., has been tested for service on 3·3, 6·6 or 11 kV systems and has a rupturing capacity of 250 MVA at 11 kV. The normal rating is 800 amps.

Operation of the switch is by means of a handle mounted on the front of the unit, and an indicating plate clearly shows the switch position. The switch is designed so that the forces associated with the current flow assist the closing of the switch and the mechanism incorporates a quick-make quick-break feature thereby taking the actual operations of making and breaking out of the operator's hands.

The operating mechanism of the G.E.C. oil switch is easy of access

At present the unit may be used in two ways. The first in the form of a multiple unit switchboard, with the busbars air insulated, compound, or oil-filled. The second is as illustrated in the photograph. This shows a ring main unit of unusually compact design, achieved by housing two of these oil-switches side by side in the busbar chamber of a standard truck-type oil circuit-breaker unit. Space is available in the unit for c.t.'s and on the front panel for meters or instruments.

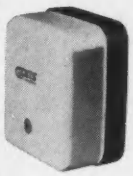
Zirconiated tungsten electrodes

THE development of thoriated tungsten electrodes for argon arc welding offered certain advantages over pure tungsten electrodes, the thoriated tungsten enabling a suitable welding point to be maintained by its greater resistance to contamination. However, direct contamination of the electrode by direct contact with the molten pool or filler wire still necessitated the immediate regrinding of the electrode, and in an attempt to increase resistance to contamination, MUREX WELDING PROCESSES LTD., Hertford Rd, Waltham Cross, Herts, have now introduced a zirconiated tungsten electrode, it is claimed, even if it is allowed to touch the molten pool and filler deliberately, resulting contamination does not "wet" the point of the electrode and form a globule on the tip.

A Neat New Transformer by Gent

ENTIRELY new in design is a new transformer with an output of 2 amps and suitable for domestic bells and chimes and certain industrial uses, which has been announced by GENT AND CO., LTD., Faraday Works, Leicester.

Known as the Fig. 1139, it will supersede the 1138 but although the capacity is increased price remains at 18s. list. It has a moulded black plastic base and a cream enamelled metal cover.



Stylish simplicity is evident in the design of the Fig. 1139

Windings are vacuum impregnated with thermoplastic compound and are fully interleaved. Guarded terminals are totally enclosed by the cover. For normal 200/250 V supplies it has fused secondary tappings of 4/8/12 V.

Tungsten Tipped Rotary Drills

TWENTY-FIVE years' experience in the use of tungsten carbide for tipping drills is being passed on to users of electric hammer drills made by VICTOR PRODUCTS (WALLSEND) LTD., Wallsend-on-Tyne, Northumberland, who have introduced a range of tungsten tipped rotary drills.

The addition of a tungsten tip to drills made from Sheffield best quality tool steel ensures maximum cutting power with more speed into brick, stone or concrete. Loss of gauge is reduced to a minimum.

The cutting angle and degree of hardness are important considerations in the manufacture of Victor tungsten tipped rotary drills which are available in a range of seven sizes: $\frac{3}{8}'' \times 3''$, $\frac{1}{2}'' \times 4''$, $\frac{5}{8}'' \times 6''$, $\frac{3}{4}'' \times 8''$, $1'' \times 9''$, $1\frac{1}{4}'' \times 12''$, $1\frac{1}{2}'' \times 12''$.

An Electric Calculating Machine

LATEST addition to the range of calculating machines by BADENIA LTD., Russell Hse, 9 Adam St, W.C.2, is the T.A.V. 17, a lightweight portable electric calculating machine which the firm say will give the answer to almost any mathematical problem within a few seconds.

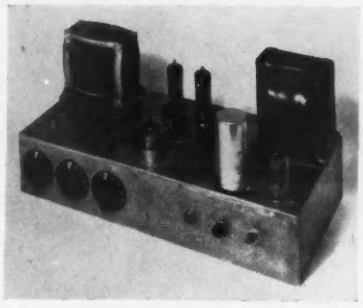
Its "feather touch" is a feature which will gain great popularity. Although fully automatic and electrically-driven by internal motors suitable for all usual a.c. or d.c. voltages it can be operated manually if desired.

The "feather touch" of the T.A.V. 17 makes calculating work less fatiguing

The capacity of the T.A.V. 17 is 10 by 8 by 17. It has a stepped-up keyboard for good visibility and easy manipulation. Direct addition and subtraction. Automatic clearance of keyboard when adding and subtracting. Multiplication simultaneous with entry of multiplier. Automatic entry of multiplier combined with automatic carriage movement. Positive and negative multiplication and division. Fully automatic division. Full keyboard —amounts entered as read. Coloured keys facilitate "keying-in" of amounts. Split lock controls for accumulating partial results if desired. Selling price is £290.

Mullard Develop Amplifier Circuit

AS part of their service providing valve users with technical information on valve applications, MULLARD LTD, Century Hse, Shaftesbury Ave., W.C.2, have designed a five-valve, low amplifier circuit which is aimed at providing both home enthusiasts and equipment manufacturers with high quality sound amplification at a relatively low cost. The amplifier, which enables full advantage to be taken of Mullard's latest audio valves is sufficiently sensitive to permit the use of most popular makes of gramophone pick-ups without pre-amplification.



Mullard developed this amplifier as part of their service to valve users

At a demonstration last week, the amplifier (used with well-known makes of pick-up and loudspeaker) gave a creditable performance and the claim that harmonic distortion is less than 0·4% at 10W output was not difficult to believe. Its frequency response is almost flat from 10 to 20,000 c/s. Conventional in form, the circuit, briefly comprises a single-ended, high gain pentode (EFH6) feeding a cathode-coupled phase splitter stage which employs a high-mu double triode (ECC83). The two outputs of this stage drive the grids of two output pentodes (EL84) in push-pull. Negative voltage feed back is applied from the secondary of the output transformer to the cathode of the input valve. Known as the Mullard 5/10 circuit, the amplifier employs no smoothing choke to reduce cost still further. It has been estimated at costing some £13 to build, buying equipment at list price.

For the Electrical Trade

Improved Mazda "Natural" lamps

CONTINUED research and development in the Mazda lighting laboratories has resulted in improved Mazda Natural colour fluorescent lamps giving 16% more light.

THE BRITISH THOMSON-HOUSTON CO., LTD, Crown Hse, Aldwych, W.C.2, say that great care has been taken to retain the same colour rendering properties which have made this lamp popular. Prices of the lamp are 15s. 5d. including purchase tax for the 5 ft 80 W lamp and 13s. 11d. for the 4 ft 40 W lamp.

Thermostats for Hurseal models

FURTHER to the note in our issue 27 May about the TV radiators by HURSEAL LTD., 229 Regent St, W.1, we understand that their "TV" range of portable panel and column radiators and their "P" range of panel or wall radiators can now be supplied as from today 1 July with a built-in thermostat at no extra charge.

The "F" comprehensive range of column radiators can have a built-in thermostat incorporated at an additional charge of £1 nett including purchase tax.

TRADE PUBLICATIONS

TIME SWITCHES.—New and reconditioned time switches available are detailed in the latest list published by J. W. Hughes, College Hse, 3 St Thomas St, London Bridge, S.E.1.

LIGHTING.—Packaging and colliery engineering are two industries which will be interested in folders specially produced for them by The Benjamin Electric Ltd., Brantwood Works, Tariff Rd, Tottenham, N.17.

RECTIFIERS.—New booklet R.248 dealing with Hewittic rectifiers for mining service has been published by The Hackbridge and Hewittic Electric Co., Ltd., Walton-on-Thames, Surrey.

TELECOMMUNICATIONS.—A leaflet issued by the Automatic Telephone and Electric Co., Ltd., Strowger Works, Liverpool, describes the company's activities as consultants' engineers and manufacturers.

NEWS OF THE WEEK

Border Farms may have Power Soon

S.E. Scotland allotted £65,000 for development in N.E. Area

A REPORT on the meeting between the S.E. Scotland Consultative Council's deputation and the B.E.A. at the end of last month on the question of rural power supplies to the Border districts was made at the Council meeting in Edinburgh recently. As reported in our 17 June issue the deputation sought and were granted an interview with the B.E.A. to discuss the possibility of a larger grant to extend electricity supplies to that part of England administered by the S.E. Scotland Board and adjoining the N.E. Board's administrative area. Particular concern was felt because although the English Board were able to connect premises within a year, their Scottish counterparts could hold out little hope for enquiring consumers.

The deputation's visit to London was successful for they obtained an additional allocation of £65,000 for the Board to spend on development in the district. Encouragement thus received, however, was shortlived, because the Board's chairman pointed out that he may not be able to use the money because of his staff problem, provision of surveys, wayleaves and other reasons. He reminded the Council that he had to contend also with supplying power to new housing estates, industrial developments, and coal mines as well as rural communities. Nevertheless, there are still high hopes for North Northumberland and a further deputation has been appointed to press the matter with the Board.

If the latter accept the new allocation, the first scheme to be undertaken will be the Kyloe project. The estimated cost of that is £24,000, and any balance would be spent on seven other schemes which the Board have not been able to include in their programmes, as it was felt that these further schemes could not be accepted for ten years.

Automatic Control and Computing

THE new Division at the National Physical Laboratory, formed by the amalgamation of the Electronics and Control Mechanisms sections, is to be known as the Control Mechanisms and Electronics Division. Field to be covered by this new group is the automatic control of industrial, administrative and experimental operations, and the development of techniques and equipment for date processing and computation. The Division is developing automatic or semi-automatic equipment to digest the innumerable records produced during modern research and development into the form of graphs or typescript ready for immediate use. Officer in charge is Mr R. H. Tizard.

Research Station Explosion

THERE was an explosion in the condenser room at the Reyrolle Research Station last Sunday afternoon. The cause of the explosion is not yet known. It occurred during the testing of high-power switchgear and was of sufficient violence to penetrate into a workshop immediately below the condenser room and shut off by a metal gate.

Three workmen were injured, two of whom were detained in hospital. Material damage was confined to some of the measuring equipment and connections thereto; no major item of equipment was involved. It was hoped to re-start testing without much delay.

L.C.C. SUPERVISORS GET NEW PAY RATES

THE rate of pay of inspectors of electrical work employed in the Chief Engineer's Department of the London County Council, is to be changed. Back in November 1943, the Council decided that the rates of pay of these inspectors should rise or fall by 2s. 6d. per week for every ½d. an hour by which the total weekly pay, excluding overtime, of the electricians is increased or decreased. The Council's Establishment Committee now reports that with the reduction of the normal working week for inspectors and electricians to 44 hours, this formula has resulted in the inspectors receiving a much higher rate of increase than the workmen supervised, the existing rates now ranging from £11. 0s. 6d. to £11. 12s. 6d. It is therefore proposed that the duties of these inspectors shall be carried out by a new grade designated "supervisors of electrical work" with a salary scale of £10. 10s.—5s.—£11. 5s. But the Council's 56 existing inspectors who transfer to the new grade of supervisor, will be granted personal allowances of 7s. 6d. a week so that their rate of pay will not be worsened. The Committee estimate the ultimate annual saving at £1,380.

London Conference on Electron Microscopy

OPENING today in London (5 p.m.) is the International Conference on Electron Microscopy. It has been organised by the electron microscopy group of the Institute of Physics and will continue until 21 July. At the same time there is an exhibition of commercial apparatus and micrographs which should provide an excellent opportunity for examining many first-class instruments. Full programme, with abstracts of 160 papers to be presented on some twenty subjects, is included in a Conference Handbook available from the joint secretaries of the Conference at 47 Belgrave Sq, S.W.1, price 2s. 6d.

B.E.A. opposes Submission of Plans of Furnaces

A CLAUSE in the Birmingham Corporation Bill which is designed to give the city council an opportunity of making suggestions to ensure that new furnaces will not emit smoke and grit, has been omitted from the Bill. The Bill came before the House of Commons Select Committee last week. The B.E.A., F.B.I., and Birmingham Chamber of Commerce petitioned against the clause. In explanation of the aims of the clause it was stated that although it was an offence under the 1948 Birmingham Act to install a furnace which could not be operated continually without making smoke, prosecutions had to take place within six months. This was almost impossible in the time. If the clause was approved, firms who had plans approved would be assured that no prosecution for subsequent smoke emission would be made against them. Furnaces fired by gas, electricity and oil were exempted from the provisions.

The B.E.A. asked the committee, that if they approved the clause, a proviso would be added to exclude furnaces in power stations. Under the existing general law, the Corporation has already received plans for apparatus of that type. The F.B.I. and Chamber of Commerce pointed out that no one in the City had constructed an unsuitable furnace since 1948, in which case how could it be said that the Act was ineffective. Moreover, they submitted, a Government Committee was dealing with the subject, and such a clause would be inappropriate while the committee was still sitting.

Education Certificate caters for Technical Students

FOR some time the view has been held that there should be an examining body to provide a General Certificate of Education which meets the special needs of students taking technical and commercial subjects in secondary schools and further education establishments. The establishment of the General Certificate in place of the former School and Higher School Certificates has facilitated the realisation of such a scheme, and plans now exist for examinations for the new Certificate to be held in June and July, next year.

Members of the Associated Examining Board, as the organisation granting the new Certificate is known, include the City and Guilds of London Institute, and the London Chamber of Commerce. In addition, there are technical institute associations and representatives of teachers, universities and professional bodies.

There are two ways in which the new examination should prove of major benefit. It will provide a general educational qualification for university or professional entrance examinations without uneconomical disturbance to the main course of professional studies, and it may be used to unify and raise the standard of entry to National Certificate Courses. This standard varies widely at present.

There are many new subjects amongst those acceptable for the new examinations. Latin and Greek are notable absentees, but such subjects as technical and commercial mathematics, electronics (at advanced level, in its own right) engineering workshop theory and practice, and engineering physics make their appearance. Sample question papers, regulations and syllabuses should be ready in September next. Those interested should write to the Secretary to the Associated Examining Board, 31 Brechin Place, London, S.W.7.

N.U.M. told of Shortage of Technicians

LONG term planning and the dearth of technicians in mines were two subjects dealt with by Sir Hubert Houldsworth in his speech at the annual conference of the N.U.M. last week. The industry was trying to meet the country's urgent and insistent demands for increased output, and at the same time carry out an enormous investment and reorganisation programme, he said. Technically today's output depended to a large extent on what happened nearly a decade ago. Sir Hubert said that money had to be spent usefully and that could only be assured if schemes were properly planned and executed.

On the subject of technical staff, the N.C.B. chairman said a more ready acceptance of scientific knowledge was needed at all levels, as well as a more exacting training of first class brains. Capital works were often delayed because of the shortage of technical men for both the operative work of running the pits and for planning, and also because of the reluctance of men on the operative side to transfer to planning work. Practical steps were being taken to facilitate that transfer. He said it was unfortunate that all scholarships offered could not be filled in any one year. Nevertheless, 426 scholarships had been awarded and 200 of those will soon have graduated and passed on to practical training.

OFFICIAL PUBLICATIONS

FUEL RESEARCH 1953. Report of D.S.I.R., published by H.M.S.O., 2s. 6d. (See page 81.)

BRITISH STANDARDS. B.S. 2488. 1954: Preferred Values and Associated Tolerances of Resistors and Capacitors for Telecommunication Equipment.

Amendment Slips. P.D. 1895 (amending BS 638, 1954) Arc Welding Plant and Equipment; PD 1890 (amending BS 1363, 1947) Fused plugs and shuttered Socket Outlets; PD 1886 (amending BS 1539, 1949) Moulded Electrical Insulating Materials for Use at High Temperatures; PD 1906 (amending BS 1671, 1951) Domestic Electric Kettles; PD 1907 (amending BS 1732, 1951) Domestic Electric Irons; PD 1900 (amending BS 2046, 1953) Protective Transformers.

Less Smoke in Manchester

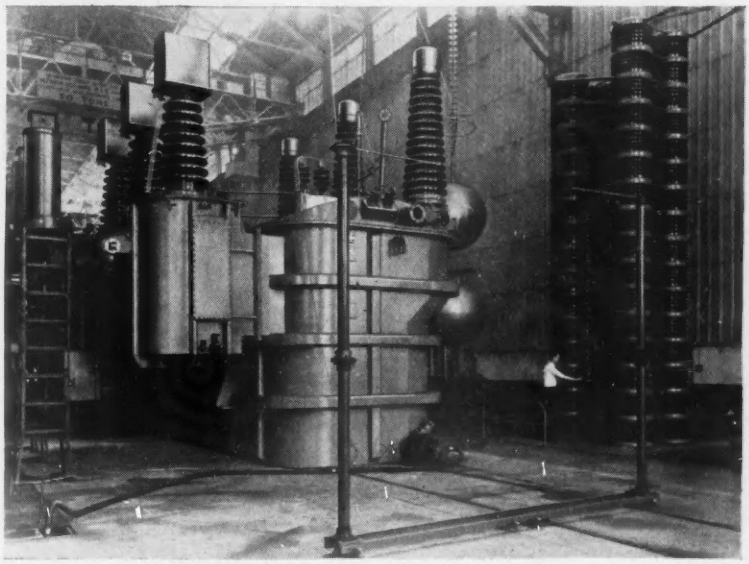
MANCHESTER'S plans to extend their smokeless zones have taken a further step forward. Proposals to increase the present 104-acre area by 130 acres has now been approved by the Ministry of Housing and Local Government and became effective from 1 May. This extension in the city centre affects more than 500 business premises

B.E.A. Claim for Pre-Vesting Day Assets

A CLAIM for £38,375 brought by the B.E.A. against Morecambe and Heysham T.C. was heard in the Chancery Division. Mr Justice Harman reserved judgment. The claim is in respect of assets of the corporation's electricity undertaking accrued during the two years immediately preceding nationalisation. Those assets, the B.E.A. allege, were unlawfully applied to aid the local rates with the result that the Authority took over an overdraft of £50,000 on vesting. That sum would have been a good deal less if the £38,375 had not been used for other purposes. Against this it was stated on behalf of the council that the Morecambe Corporation Act of 1924 provided for the pooling of municipal reserves and contained no express restrictions on the use of surplus revenue. The money was carried to and formed part of the general rate fund. The Corporation did not hold the money in their capacity as owners of the electricity undertaking.

B.E.A. will not have New H.Q. at Beeston

THE appeal by the B.E.A. against Nottinghamshire County Council's refusal to pass plans for their Beeston Fields headquarters has been dismissed by the Ministry of Housing and Local Government. The Ministry's decision was contained in a letter sent to Beeston and Stapleford U.D.C. Site chosen for the new headquarters building to accommodate 500 employees was in Cow Lane, Bramcote, a residential area bordering the local golf course.



One of the 102 MVA 132/275 kV three-phase auto-transformers with on-load tap changers being subjected to impulse tests at the Trafford Park works of the makers, Metropolitan-Vickers Electrical Co., Ltd., before delivery to the B.E.A. Eight have been ordered by the B.E.A. for their 275 kV super grid

Doomed Trams help to Show a Profit

A NET profit of £16,051 is shown in the accounts of Sunderland's tram and bus undertaking for the year ending last March. Receipts from the trams amounted to £169,916 compared with £232,534 the previous year when there were more trams in use. The trams are due to be scrapped at the end of the year and at present there are but 29 vehicles (against 164 buses) running on 2¼ miles of track. Throughout 1953-54 the trams carried about 23 million passengers.

The First Half-Century

The *Magazine of Commerce*, anxious that London should have another great international exhibition shortly has circularised a hundred British manufacturers to get their views on the subject. Of the hundred, 36 are for the exhibition, 32 against, 15 neutral, and 17 undecided. One or two objectors argued that we were a free trade country and it merely gave foreigners an opportunity of copying our methods. I remember many years ago when the Melbourne Exhibition of 1880-81 was mooted, free traders opposed it because Victoria was a protectionist colony. The exhibition was held all the same; but if both arguments were sound, the conclusion would be against any international exhibitions anywhere.—*From our issue of* 14 *July*, 1904.

Women in Middle East

THE International Federation of Business and Professional Women is to make a study of the status of women in five countries of the Middle East. This ten-month study, which is to be made in Egypt, Iraq, Jordan, the Lebanon and Syria, was announced by Dame Caroline Haslett, the Federation's president, and will be under the direction of Miss Ruth Woodsmall. To finance the project the Federation will receive $47,500 from the Ford Foundation. At present the Federation has groups in twenty countries, but not in those to be surveyed.

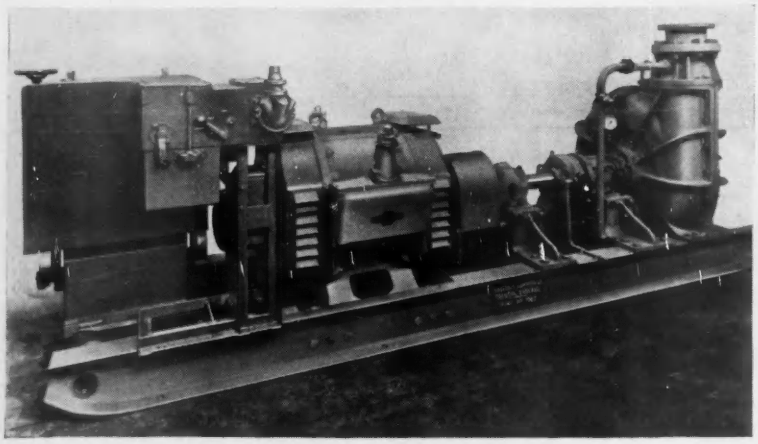
Chinese Trade Mission concludes U.K. Visit

DISCUSSIONS between the Chinese trade experts and the Sino-British Trade Committee ended last weekend. The Committee has stated there has been "a useful exchange of views and satisfactory progress was made towards reaching an understanding." In the course of the past two weeks a number of subjects were considered. These included trade systems and contacts; functions of the merchant and the use of Hong Kong; technical services and British representation in China; methods of payment and trading terms; and the registration of British trade marks. The Chinese visited a number of factories and had talks also with representatives of trade associations. It does not appear that any really conclusive result emerged from the talks. The Sino-British Trade Committee is to remain in being to follow up the discussions and have accepted an invitation to send a British party on a return visit to Peking in the autumn. In the meantime, the Committee has the assurance of the Chinese party that no special avenues of approach by British firms to the State Trading Authorities were necessary.

Coincidental with the conclusion of these talks, the British Council for the Promotion of International Trade has issued a booklet entitled "China's Foreign Trade." It is stated that China has embarked on a vast programme of industrialisation. The first Five-year Plan envisaged an expansion of production, particularly in heavy industry. The booklet goes on to state that China will be willing to buy almost every kind of engineering plant and equipment, especially machine tools, electrical and transport equipment.

SLEDGE-MOUNTED PUMP

A sledge-mounted pump and motor unit, which can be dragged across rough ground, evolved by Easton and Johnson Ltd., the Taunton pump makers, for tin mining. In the hydraulic mining of tin, earth containing the tin ore is washed from the hillside to a sump, where a centrifugal gravel pump transfers the slurry to a sluice which separates the tin deposit. Position of the sump changes continually, hence the need for the mobile pump. Electrical equipment was made by Metropolitan-Vickers Electrical Co., Ltd. Motor is a 60 *h.p.* 485/290 *r.p.m. type Rw slipring machine, and the control gear consists of type 035 oil-break stator switch and type LF liquid rotor starter. Five units are en route to Nigeria.*



New Fundamental Particle Discovered

REPORTS from America over the week-end indicated that American physicists are excited over the discovery during cosmic rays research of a new fundamental particle, the "anti-proton." The evidence for this is taken from photographic plate recordings made during a high-altitude balloon flight. It seems that the new particle is effectively a negatively charged proton: in other words, it has the mass of the proton, but a charge of opposite sign to that usually associated with this particle. There is a direct parallel here to the "positive electron," existence of which was implicit in a theory put forward by Professor Dirac of Cambridge in 1930. Later, this was discovered, and there was at once speculation about the existence of the anti-proton.

When a positive and a negative electron are brought together, the matter they represent is annihilated, and an equivalent amount of energy released. The same thing is thought to happen with a proton and an anti-proton, but on a larger scale, for the mass of a proton is about 1,830 times that of an electron.

If the new particle does prove to be an anti-proton, then the intriguing possibility arises of a looking-glass world in which atoms are built from negatively charged nuclei with positive electrons orbiting around them. This is not necessarily implied by the discovery, however.

Floor Heating is becoming More Popular

THE popularity of space heating from elements embedded in concrete flooring is spreading gradually. We heard last week that the Star Aluminium Co. at Bushbury, Wolverhampton, has chosen this means of heating in a warehouse to be used for the storage of aluminium foil and paper. The work is to be carried out by the Midlands Electricity Board. The Board, in common with most others, have been experimenting with floor warming for some time and have tried it out in temporary premises at Wolverhampton and Walsall. Most recent installation of this kind was in the S.E. Electricity Board's premises at Orpington. Larger installations are in use in Scotland, where there is also the exemplary installation at Sighthill (Edinburgh) health centre.

INDUSTRIAL MAINTENANCE

A special monthly section of the Electrical Times

Lighting and Power Supplies in American Factories

There is always something to learn from another country's engineering practice.' It is in this spirit that Mr A. G. Thompson presents this survey of United States methods in the design and installation of factory lighting and power distribution systems. The article is based on the experience of an officer of the D.S.I.R. Building Research Station who visited North America recently. No suggestion is intended that the methods described are better than those current in this country.

ADAPTABILITY has become one of the foremost requirements in the design and construction of new factories in the United States, while the conception of the windowless or near-windowless factory is finding increasing favour. Under the leadership of a small number of large firms of architect-engineer combinations, the trend is towards single-storey factories with flat roofs, frequently uninterrupted by glazing of any kind, but otherwise broken only by monitor-type lighting or by penthouses for ventilation plant. Adaptability is achieved by the provision of adequate height, adequate bay sizes, uninterrupted floor space, adequate facilities throughout for loads hung from the roof, uniformly good artificial light, flexible power distribution, and heating and ventilation equipment capable of meeting the needs of all outdoor climates from the near arctic to the fully tropical.

Away from Daylight

The American designers appear to regard daylight as a luxury rather than a necessity. They contend that upstand roof lights add to the volume of air to be treated, and that glass adds to the heating and cooling load, to the loss of artificial light after dark, and to maintenance costs. Other arrangements put forward are that roof lights do not enable the capital cost of artificial lighting to be reduced, and that in many industries overhead gear is being increased to the point where it interferes seriously with daylighting.

For these reasons, there appears to be a definite trend towards artificial lighting and vision strip windows. The artificial lighting is mainly fluorescent and is always on, regardless of any daylighting.

The usual practice, in factories where fluorescent lighting is employed, is to use only medium white lamps, generally of the 5 ft, 100 W hot cathode type, the levels varying within ±10 foot-candles from 35 foot-candles. The mounting height is at or about truss level, which used to be 16 ft above the floor but is tending to rise and is now 18 or 20 ft. There is seldom any attempt to relate lighting to the visual difficulties of the task and local lighting is rarely seen.

Upward lighting is regarded as unimportant, the ceiling being forgotten in automotive works and similar factories. The unlighted ceiling seems to accentuate the differences in comfort resulting from various patterns of fittings. The maximum discomfort is experienced from rows of isolated units, the most comfortable conditions being provided by groups of rows in bay-length.

Perforated Lighting Fittings

Although at present only downward components are normally employed, the opinion has been expressed that a "revolution" in factory lighting can be expected, which will have as its basis an upward component of at least 25% and cut off 30-35° or more. This view is based on the finding that, if fittings are perforated to give upward components, the resulting convection currents keep the surfaces much cleaner, and fluorescent lamps are able to operate at much nearer their proper temperature. A 1,500 W incandescent lamp, in a dirty atmosphere, dropped only to 93% efficiency in an open reflector, but went down to 63% in a closed fitting. On the other hand, some designers maintain that perforated fittings distort more easily, so that after a few cleanings and alterations they do not return to true lines. This view does not, however, appear to be widely held.

500 and 750 W internally silvered filament lamps are now available in America, which are claimed to have better than 80% efficiency on maintenance, including dirt and lumens losses. A disadvantage is that they tend to fracture if water drips on them, so that a shield of some description is required. At present the silvering runs high up the neck, but it is being dropped to allow more upward light. It is stated that this lamp is particularly useful for "punching" light down into deep, close-packed machinery.

3 kW mercury vapour lamps are sometimes installed in high bays, where a "punch" downward is said to be needed, but they are mixed with incandescent sources, partly because of the lag of 7 minutes in relighting mercury lamps should any power break occur, and partly because the trade unions are not in favour of mercury vapour lighting alone.

The high first cost of mercury vapour lighting tends to be balanced by low maintenance cost. In making comparisons, however, it has to be borne in mind that riggers are paid much higher wages for working at great heights, so that reduction in the number of units to be fixed leads to lower installation costs. It is, therefore, economical to fit a very high power unit in high factory bays. It is said that at the Chevrolet works mercury units took the place of 5,000 fluorescent units at a saving of $125,000. Where electricity is 1 to 1¼ cents a unit, probably equivalent to ¼d.—⅜d., incandescent and fluorescent lighting are equally cheap in total cost.

Lamp Life

At the factory of the Simonds Saw and Steel Co., Fitchburg, Mass. (claimed to be the first windowless factory in the U.S., and also to have the first big fluorescent lighting installation), a lamp life of 10,000 hours is reported to be obtained from 40 W long life hot cathode lamps.

Some designers consider it desirable

that electric power should be at a uniform height throughout the workshops, so that machines can be shifted about at week-ends without altering the length of riser to the power source. Flexibility is, in fact, regarded as a major requirement of power distribution in automotive factories. The general practice of one firm of designers is to provide 480 V power along bus ducts 40-50 ft apart, the exact spacing being determined by the general machine population. Lighting is then fed either by 3-phase 4-wire 277/480 V, with light distribution between earth and any phase, or alternatively by 480 V, not earthed, transformed to 120 V with a 3-phase transformer to secondary voltage, the phases being kept balanced. The former method is reported to permit control of large areas of lighting from one motor starter, but is only economical where large areas are lit for long periods.

Substations in the Roof

There may be three or four substations in a factory 500 by 1,000 ft, stepping down from, say, 13,000 V and running up to 2,000 kVA. They are usually situated in roof spaces and each one handles an area of 200-300 ft square. This system gives good voltage conditions compared with a single transformer and long runs. In order to minimise fire hazards, the primary cable is usually kept below ground, even if armoured.

The method of suspension is to some extent dependent on local regulations. Where permitted, the fittings can be fixed direct to "messenger cables," which are steel cables, about $\frac{1}{8}$ in. diameter, stretched very tightly across the bottom chords of trusses, and the power supply is run into the tops of the fittings. If the local regulations require that the power should run in conduit, the fittings are commonly attached to conduit, which in turn is fixed to messengers, running either along or across them.

According to some designers, the greater height of trusses above floor level is an advantage, because the spacing of rows is on a 1:1 ratio from the working plane and is correspondingly increased, leading automatically to continuous rows of fittings in place of the spaced units usual at lower levels. In many factories the lines of fittings are only about 10 ft apart. These continuous runs are said to be more economical to install than units spaced out.

At the Chrysler-Trenton plant the messenger cables are strained between trusses, at 10 ft intervals, clipped to the trusses, and supported between them from the ceiling if necessary. To these cables are attached all electrical conduit, from which conduit drops occur to machines. Separate messengers support the whole of the continuous troughs of fittings, the wiring being carried by a conduit run along beneath the messenger, which receives the fixtures direct. Two busbar systems are used, one being for 2,000 amp supply and the other for 600 amp at right angles. From this is taken the lighting, tapping positions being provided at 2 ft intervals.

An ingenious trunking, developed by a firm of designers in association with an electrical manufacturer, allows fittings to be suspended anywhere and tapped for power at any point, according to the type of power used. It consists of an inverted "U" shaped duct, open along the bottom, which is a 50 amp, 3-phase 3-wire bus. By the use of polarised plugs it is possible to tap either live wire and use it separately for light, and also for night lights and other purposes. A switch circuit-breaker can be clipped in wherever wanted and can receive a fixture at either end. Though this arrangement is expensive, it is said to be cheaper than three circuits.

Accent on Standardisation

Architects in the United States endeavour to save every possible day on construction in order that clients may get into production with the minimum delay. This leads them to take maximum advantage of the opportunities afforded by standardisation. For example, stanchions are invariably of H-sections and appear to be always of the same dimensions, though occasionally they are put in pairs when the loads of cranes have to be taken. This has led to the development of standardised electrical control gear which fits neatly into the recess on the side of the H-column.

In American offices lighting is now characterised by the extensive use of pale green, "anti-sun" glass and louvre blinds on windows to reduce heat glare, together with the continuous use of artificial light at 50 or more lumens/sq ft, up to 90 or 100. This double reduction of natural light in association with the continuous use of artificial light gives comfortable conditions, and has the great practical advantage that areas remote from windows seem just as satisfactory as those near to them. This is an important consideration in a country where it is common practice to have clerical staffs in large groups on an open floor, together with the managers and sub-managers.

As in workshops, artificial lighting in offices is usually provided by units directing light downwards only. These may be mounted in the plane of the ceiling, which usually consists of 12 in. square sound absorbent tiles, or they may be suspended close to the ceiling. Lights mounted in the former manner tend to be less obtrusive by day, but are more glaring at night by contrast with the unlit ceiling.

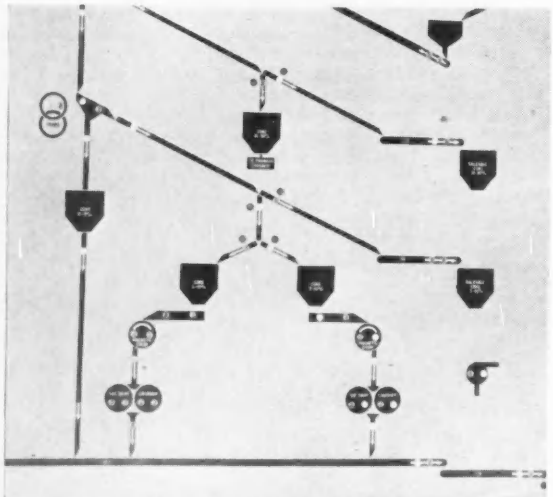
According to some large design firms, electrical services cost 10% of total factory costs, but one leading designer puts the proportion as high as 20%. It has also been stated that a typical fluorescent lighting system of the type described costs 1 to 2% of the total payroll and is regarded as the best investment in the factory.

Acknowledgments

The information given in this article was obtained from the Building Research Station of the Department of Scientific and Industrial Research, one of whose officers visited the United States as part of the Department's research programme on factory design.

Indicator Diagram Pinpoints Plant Failure

THE flow diagram shown here is part of the control indicator diagram for the coke preparation plant of the Margam Works of the Steel Company of Wales. Manufactured by Standard Telephones and Cables Ltd. It gives a central indication of the operational state of the widely dispersed sections of the all-automatic plant. Red and green lamps operated according to the position of the starting contactors, indicate whether a particular motor is running or still. Failure of any motor immediately shows up on the diagram, by the change to a red light. It is considered that the introduction of this type of diagram assists the rapid re-adjustment of plant in the event of a stoppage, and the issuing of instructions for setting up alternative flow paths.



The diagram is constructed of a durable plastic material, with the coloured symbols, signs and lettering bonded-in during the manufacturing process. Telephone type relays, working on a 50 V d.c. system operate the indicator lamps. The layout of the diagrams was evolved by the consulting engineers, Messrs. McLellan and Partners in conjunction with the Steel Co. of Wales.

REPAIRS TO A MILL MOTOR

by S. S.

THE following experience concerns a 400 h.p. d.c. motor driving steel mill rolls and the first indications of unsatisfactory conditions were signs of movement of the fly-wheel on the shaft seating. A close inspection revealed that there was a gap of approximately 0·012 in. between shaft and boss over the quadrant between the two key-ways, but there were no visible cracks in the shaft or wheel. The removal of the

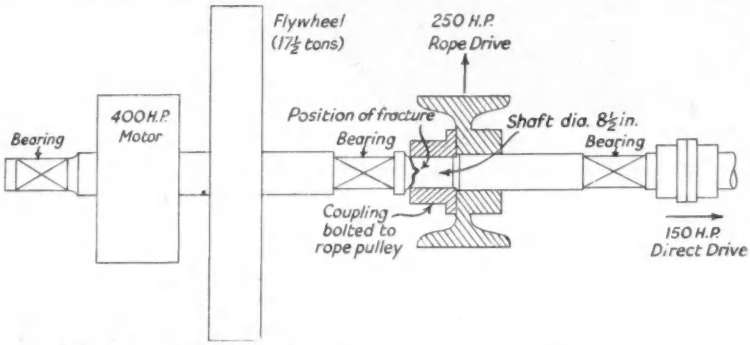


Fig. 1 (above) shows layout of 400 h.p. motor and flywheel for rolling mill

latter presented very considerable difficulties with the prospect of a prolonged stoppage of production, and it was therefore decided to effect a repair by securing the fly-wheel *in situ*. The general arrangement of the motor, fly-wheel and driving shaft is shown in Fig. 1, and the method of repair adopted is illustrated in Fig. 2. This involved the fitting of two shrink rings, one on each end of the fly-wheel boss, which was first machined to provide a true seating for the rings. Each ring was split in half to enable it to be positioned round the shaft, the two halves being then welded together in a jig to the required size prior to shrinking the ring on the fly-wheel boss. A shrinkage value of 0·039 in. was allowed and steel shims were first inserted in the gap between shaft and boss.

This repair proved very effective and during nearly four years subsequent service, there have been no signs of further looseness of the fly-wheel on the shaft.

Welding Repair

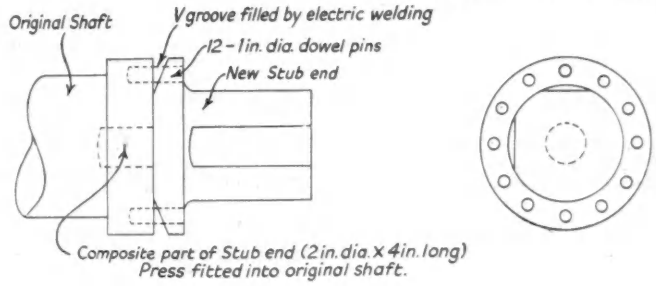
Trouble of a different nature was, however, experienced about three years after the fly-wheel repair, and in this case the shaft fractured immediately beyond the final reduction in diameter where it entered the coupling. The fitting of a new shaft would have been even a bigger task than removing the fly-wheel, and it was again decided to effect a repair, this time of the broken shaft, *in situ*. The fractured section was machined back to the larger diameter, and a new stub end was made and keyed into the shaft as indicated in Fig. 3. Twelve holes, 1 in. dia. were then drilled through the flange of the new end and into the original shaft to accommodate steel dowel pins, which were finally secured by filling up the peripheral groove between the original shaft and the stub end with electric welding.

This method of repair, which enabled the mill to be returned into service after seven days, came under severe criticism, there being conflicting opinions regarding the strength of the repaired joint, and as a further fracture occurred in about a month's time the criticism at first appeared to be justified. Detailed inspection, however, revealed that the material of the new stub end had fractured in practically the same position as in the previous case, the repaired joint being intact and perfectly sound. A second repair was therefore carried out on similar lines to the first except that additional keying of the dowel pins by means of Allen screws was effected.

Cause of Failures

The primary cause of the shaft failures was subsequently traced to the unsatisfactory condition of the mill drive and bearings, and since these were suitably overhauled, the equipment has continued to give trouble free service.

Fig. 3 (below) shows the method adopted for repairing the broken shaft end in position


Original Shaft
V groove filled by electric welding
12 – 1 in. dia. dowel pins
New Stub end
Composite part of Stub end (2 in. dia. x 4 in. long)
Press fitted into original shaft.

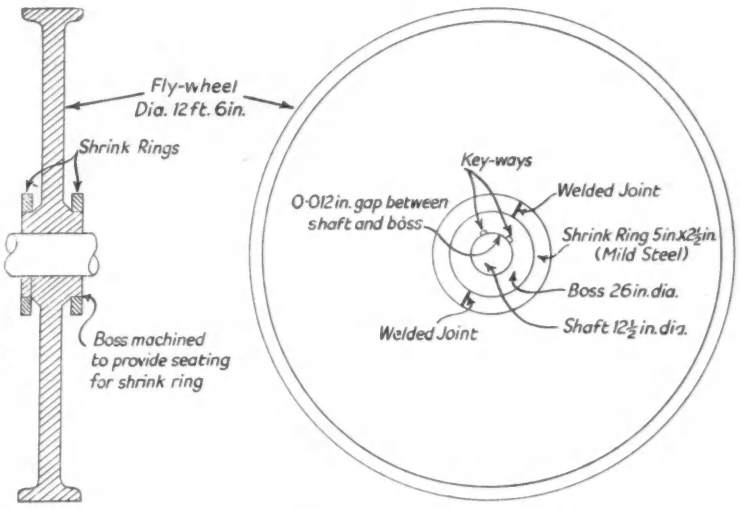


Fig. 2 (above) shows the method of securing the loose flywheel in position

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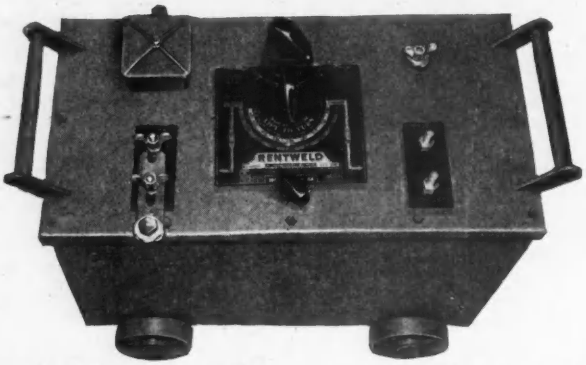

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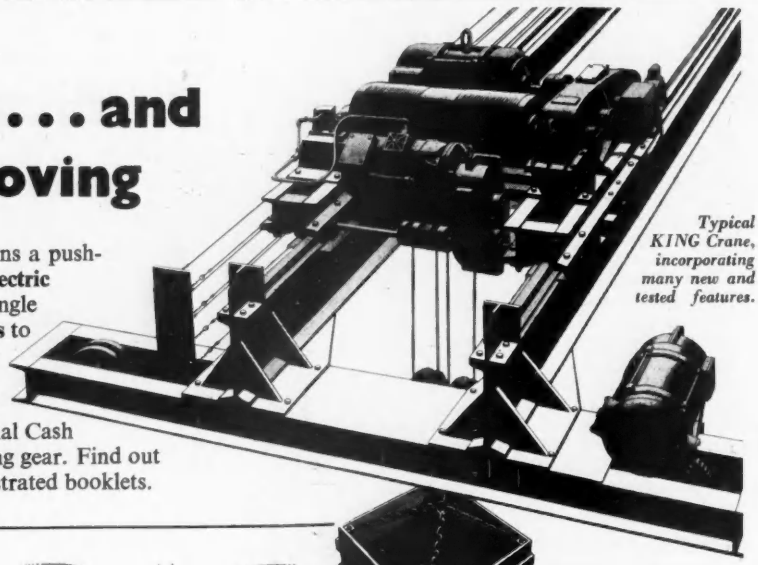

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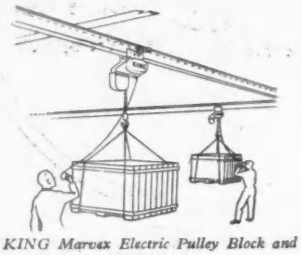
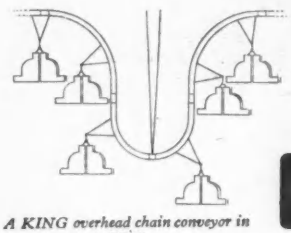
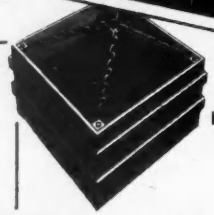


A KING Marvax Electric Pulley Block and runway



A KING overhead chain conveyor in action



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Reversing Small Single-Phase Motors

DATA SHEET 7

THE need for reversing small motors occurs relatively frequently in day-to-day operations. The notes in this and later articles are intended to assist in this operation.

I.—Squirrel cage split phase or capacitor start motors.

Four leads emerge from motor which is started from a remote position either automatically or manually. **To reverse, change over either the starting or the running circuit leads.**

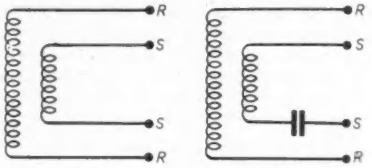


Fig. 1. Basic capacitor and split-phase connections

If the four leads emerging from the motor are unmarked the Running (R) circuit may have larger flex tails than the Starting (S) circuit. Should, however, the four leads be identical it is not always easy to determine which feeds the Starting winding. In general, for normal f.h.p. motors, the S winding has the higher ohmic value and if the motor is incorrectly connected it will be:

1. Noisy.
2. Lacking power.
3. Running hot.
4. May fail to reach normal speed.

On the other hand very small motors may have the running circuit with the high resistance and in addition motors are frequently found with the R and S circuits absolutely identical, in gauge of wire, number of turns and in their relative positions in the stator slots. In such a case either circuit can be chosen for the R circuit.

Alternative English Markings

The markings below are the commonly occurring letter and colour markings of the running and starting windings:

R—Black	White	Black	Black	Black
S—Red	Red	White	Red	Red
S—Red	Green	Yellow	Yellow	White
R—Black	Black	Blue	Blue	Blue

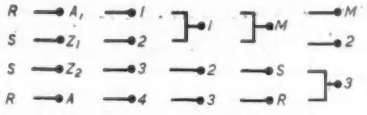


Fig. 2. Alternative terminal markings. Correct marking for extreme left A_1, Z_1, Z_2, A_2

Similar markings are used when an automatic switch is incorporated.

American Markings

American Standards Association

Before 1938 R—T_1	After 1938—T_1
S—T_5	—T_2
S—T_8	—T_4
R—T_4	—T_3

Westinghouse

Before 1930 R—M_1	After 1930—T_1 Red
S— S_1	—T_5 Blue
S— S_2	—T_8 Black
R—M_2	—T_4 Yellow

Ohio Electric Motors	*Robins and Myers*
R—Black	R—1 Grey
S—Brown	S—5 Blue
S—Brown	S—8 Black
R—Black	R—4 Green

To reverse any of the above connections change over either the S or R leads.

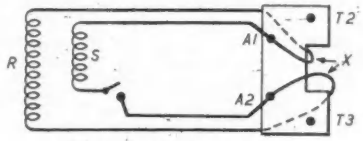
If windings are in two sections for series-paralleling

R circuit, T_1—T_5 and T_3—T_7
S circuit, T_2—T_6 and T_4—T_8

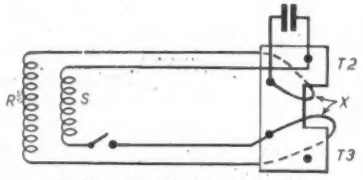
Reversal of rotation is usually effected by changing-over the ends of the complete running circuit after having connected the two sections in series or parallel for the required voltage. Do not inadvertently reverse any single section of the winding.

II—Motors having automatic switch integral with motor

In this type of motor, the switch usually acts also as a terminal board. Since one end of the S winding is attached internally to the switch plate, it is usual to reverse the R windings. In many motors the two leads are left long, and they connect to the top of the terminal board.



Mains connected to A1 and A2



Mains connected to A1 and A2

Fig. 3. Connections for automatic integral switch

To reverse, change over the leads marked X.

III—Non-reversible split-phase or capacitor start motors

Some motors, e.g., those designed for use with washing machines and refrigerators, where the normal rotation is unidirectional, cannot be reversed without workshop attention, because the joint X (see below) is buried in the windings.

Although the joint X is inside the motor it can if necessary be opened up and the motor reconnected internally.

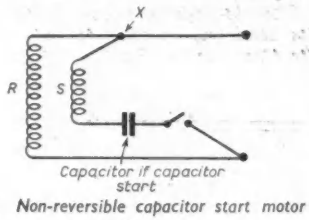


Fig. 4. Non-reversible capacitor start motor connections

IV—Reversal of swing connected motors

In this type of motor, three leads are brought out. In the first of the diagrams given, **to reverse, change over black and blue leads.** In the second, **join either 1 to 2 or 2 to 3.**

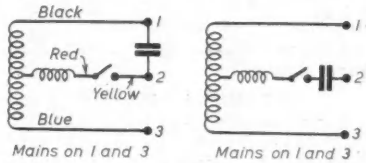


Fig. 5. Two types of swing connected motors

V—Capacitor start, capacitor run motors

Reversal is similar to the capacitor start machines and provision is usually made for this by the makers. When two separate capacitors are fitted to these motors do not inadvertantly change over these capacitor leads on the terminal block. Other machines may use two similar identical capacitors, in parallel for starting and in series for running. Such switching is not integral with the motor but is by remote control.

VI—Permanent capacitor motors

These motors are somewhat restricted in their application because one condenser only has to act both as a starting and a running capacitor, and as the optimum value for starting would be too great for the running conditions a compromise must be made and the motor therefore will not develop the starting torque of a normal capacitor start machine.

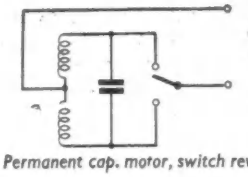


Fig. 6. Permanent cap. motor, switch reversing

Reversal follows the general procedure stated in (1) but it should be remembered that the running and starting winding in these motors are frequently identical.

A variation is illustrated in Fig. 6 where reversal is effected by switching.

VII—Inverted squirrel cage motors

In this type of motor the machine is, as it were, turned inside out. The outer shell is the armature and has the normal arrangement of rotor bars and end shorting rings, soft soldered. The stator, somewhat similar to an alternator rotor, revolves and current is fed to it via two radial slip-rings, behind which is housed the automatic switch to take the S windings out of circuit when the motor is up to speed.

The slip-rings have three terminals at the back, one on one side and two on the other side, see Fig. 7.

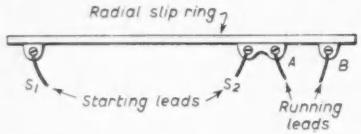


Fig. 7. Terminals on inverted s.c.m. slip-ring

To reverse change over the running winding at A and B. These two leads are either of different colour from the starting lead or may have a different soldering terminal. In case of difficulty, the S circuit can be traced by manually opening the automatic switch (behind the slip-rings) and locating lead S_2 by a bell set or series lamp, see Fig. 7.

VIII—Shaded pole motors

These motors, although somewhat inefficient and usually confined to powers below 0·2 h.p., are used to drive many kinds of small mechanisms. They are simple and cheap to manufacture and are met in ever increasing numbers.

There are two types: with bar copper shading ring or with wave wound shaded pole winding, using 2-3 turns of heavy wire with the ends joined.

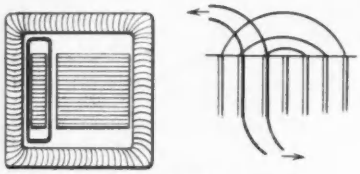


Fig. 8. Two types of shaded pole

Since both these windings are permanently connected, relative to the running winding, it follows that the direction of rotation is fixed and can only be changed by reversing the stator with respect to the rotor.

This reversal of the stator to obtain reversal of rotation is quite easy in some simple shaded pole motors but extremely difficult in others, where the stator is pressed in an asymetrical housing.

To obviate this difficulty certain shaded pole motors are made with special windings permitting reversal by switching.

IX—The repulsion motor

The repulsion motor, by no means common, is easily **reversed by moving the brush rocker to an alternative position.** These positions are usually marked and the axis of the brushes is 12° to 15° approx. to the left or right of the neutral. That is to say a shift of approx. 30° is required to reverse rotation.

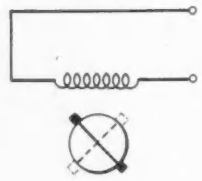


Fig. 9. Repulsion motor basic circuit

Certain variable speed repulsion motors cannot easily be reversed because the rocker is only designed to move on one side of the neutral line and therefore reversal may require a mechanical alteration to the end plate of the motor (possibly by merely shifting the end plate 90° in some examples).

Similarly other repulsion motors may be met where no provision has been made for reversal of rotation. Indeed, in many cases reversal is not generally required, such as a motor driving a centrifugal pump. Nevertheless, these motors can be **reversed by moving the stator about 30° relative to the end plates** and provision is made for this move in some stators by having alternative holes in the stator stampings through which the housing bolts pass. Any such alteration must be made with care since in one make it is possible to assemble it in 6 different ways, and the motor will try to run in each of them with excessive current draw in all the incorrect positions.

X—The repulsion induction and the repulsion start in induction run motor

In most cases the **reversal is simple and merely consists in moving the brush rocker to the alternative position.** N.B. The marks on these rockers are not always precise and a slight adjustment may improve the starting performance.

Some motors, normally unidirectional, are not fitted with an external indicator or locking screw, and the machine may have to be dismantled to reach an internal bolt or grub screw on the brush gear. Experiment may be necessary to locate the new position.

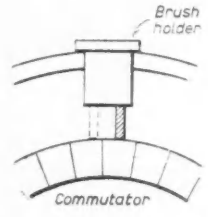


Fig. 10. Eccentric brush holder on R.I. motor

R.I. motors of foreign manufacture may use cartridge type brush holders with the brush tunnel eccentric in the body. Reversal of the motor is effected by removing the two brush holders, turning them 180° and reinserting. (See Fig. 10).

As with the repulsion motor mentioned in Section 9, some R.I. motors do not appear to be reversible, especially as the stator cannot be turned 30° relative to the commutator end plate. If the whole stator is turned end to end the equivalent brush shift is obtained but this will mean passing the four (usually) stator leads through ventilating holes in the stamping so that they again emerge at the correct end of the motor.

XI—Electrically reversible repulsion induction or repulsion start-induction run motors

These motors are frequently used for such mechanisms as curtain raising and small service lifts. Fig. 11 shows the wiring diagram, where A can be called the main winding and B and C the two auxiliary windings. These must not be confused with a windings of similar appearance used in squirrel cage single-phase motors. In the motor under discussion these windings are connected in series. Reversal is by a change-over switch.

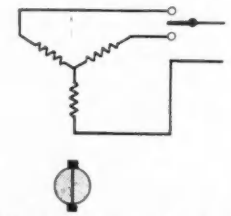


Fig. 11. Electrically reversible R.I. motor. Winding C is vertical in this diagram, A goes to the left and B to the right

A slight departure is found in Fig. 12 where four leads emerge from the motor which again are connected in series and reversal obtained by reversing one section of the two windings.

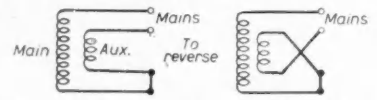


Fig. 12. R.I. motor with four leads brought out

In both cases the brushes are on dead neutral and equivalent brush displacement is obtained by the shift of the polar axis resulting from two sets of windings in series.

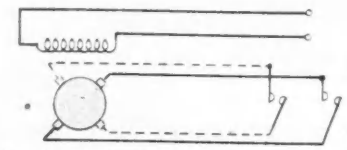


Fig. 13. Arrangement used on early French machines

Some early French machines, still in use on small service lifts, have a normal repulsion inductor stator and rotor with two sets of *insulated* brushes. Either one pair of brushes is shorted out by a remote contactor to alter direction of rotation.

What Thermal Protectors Offer

DESIGNER REVIEWS APPLICATION PROBLEMS AND POSSIBILITIES

BUILT-IN thermal protectors are finding an increasing application on electric motors. Already well established in the f.h.p. range, they are now becoming more common in larger sizes. For the plant engineer these devices offer a possibility of reducing motor burnouts while retaining full freedom to make use of inherent overload capacity.

There is probably a longer experience of the use of thermal protectors in America than in this country, and this fact makes especially interesting a paper presented a short while ago by Mr E. Kurtz, of the Spencer Thermostat Division of the American Metals and Controls Corporation. This organisation manufactures Klixon protectors in the U.S.A., and the paper was presented at a meeting organised by Salford Electrical Instruments Ltd. who manufacture the device of the same name in this country. Although the paper is written mainly for motor and appliance designers, it contains data of direct interest to plant engineers who have to purchase electric motors.

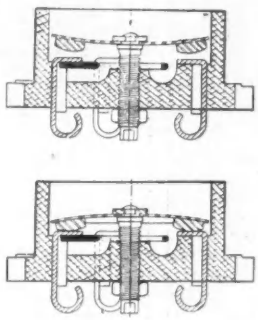
Construction

Before the paper is summarised, however, it may be an advantage to describe the form of thermal protector which is being discussed. It consists primarily of a bimetal disc which is dished to give a snap action, and a series heater. The disc carries two contacts which make and break with a pair on a baseplate. The device is connected in a motor circuit so that the motor current passes through both the heater and the disc. Besides being so connected electrically, the protector is mounted so that it is influenced by the temperature of the motor windings. Thus it is sensitive both to the slow build-up of temperature in the motor due to continued operation at low overloads, and to the sudden rush of current that occurs if the motor stalls, perhaps when starting.

Delving deeper into the characteristics of the protector, it is soon realised that the basic consideration is that the life of insulation in motors depends not only on operating temperatures, but on the time for which the insulation is exposed to a given temperature. Put in another way, insulation does not fail just because a certain temperature is reached. However, tests quoted by Mr Kurtz show that one type of Class A insulation has an average life of over 2,000 days when operated continuously at 105° C, but that this life is reduced to 650 days at 125° C, and to 180 days at 150° C. It is the purpose of the thermal protector to permit operation at a designed temperature level, but to cut out the motor when that level is exceeded for any but a very short time. This is, of course, the purpose of any form of overload protection, but with external devices such as line relays, it is not possible to take account of the existing heat condition of the motor; nor is it easy to guard against sustained overloads whose only danger lies in their being continued for a prolonged period.

At present, it seems to be agreed that thermal protectors can only be applied to new motors, because of the lengthy tests necessary to match the protection to the motor characteristics.

The temperature that is obviously of importance in motor protection is the hottest-spot temperature; it is, however, clearly impracticable to mount the thermal protector so that it will be directly responsive to this. That is where the tests already mentioned come in; the protector is mounted in some position such as, strapped to the end windings, and the temperature here has to be related to the true hot spot value. The combined effects of winding temperature and series heater must match the characteristics of the motor under all conditions. These tests are fully described in Mr Kurtz's paper, but they are not the concern of this article. The question here is rather, what standard of protection is afforded in the end, and how close to its ultimate safe rating can a protected motor be run?



Thermal protectors in open (top) and closed positions. The automatic reset type is shown

Performance

It is stated that when a protected motor is tested in a temperature controlled laboratory with its mechanical loading maintained constant, then it is possible to run it for prolonged periods within 1° C of the ultimate trip temperature. This is not possible in an actual working application, however, as there is too much variation in ambient temperature conditions over a day. In addition, there is likely to be sufficient variation in voltage and mechanical loading to cause the protector to open if an attempt is made to run close to maximum temperature. This is felt to be desirable, as in this way, overloads are restricted in duration.

There are two main types of thermal protector, designed respectively for automatic resetting after opening, and for manual resetting. The former type obviously permit cycling if, for instance, the rotor is locked due to some fault in the driven machine. This is where the thermal protector is seen to its best advantage. Some time ago, there appeared an American I.E.E. paper on this point, which dealt with changes in winding temperatures due to such factors as excess and deficient voltage frequency variations, and failure of ventilation. The tests were carried out on 1/3 h.p. repulsion start induction motor, and the greatest temperature rise permitted by the protector was 10° C above full load, and for most sets of abnormal conditions it was 5° C or less.

If a motor is subjected to overloads causing a current flow greater than the ultimate trip value, then usually the trip operates so quickly that the winding temperature reached is less than that reached under ultimate trip conditions.

Standard Requirements

Finally, since the thermal protectors have been so widely applied in the United States, it is interesting to look at the conditions for their application which have been formulated by a U.S. safety authority, the Underwriters' Laboratories. They are set out as follows:

Heating. A protective device shall prevent the motor with which it is appropriately used from reaching a temperature higher than 125° C when the motor is running under any condition of load. The protective device shall also prevent the motor from reaching a temperature higher than 150° C at any time when the rotor is stalled; except that, during the first ten minutes of cycling under stalled-rotor conditions, the motor may attain peak temperatures higher than 150° C but not higher than 200° C, provided that the motor-protector combination is shown by special investigation to be suitable for the purpose. If the device is of the automatic-reset type, the stalled-rotor test shall be continued for 72 hours. Temperature measurements shall be made by means of thermocouples. There shall be no manifestation of a fire hazard during this test.

Stalled Rotor automatic-reset type. The automatic-reset devices shall operate for a period of 15 days, unless they permanently open circuit prior to the expiration of that time, with the motors for which intended stalled on the line of any convenient voltage within 10% of the motor rating. During this time there shall be no permanent injury to the motors, including excessive insulation deterioration.

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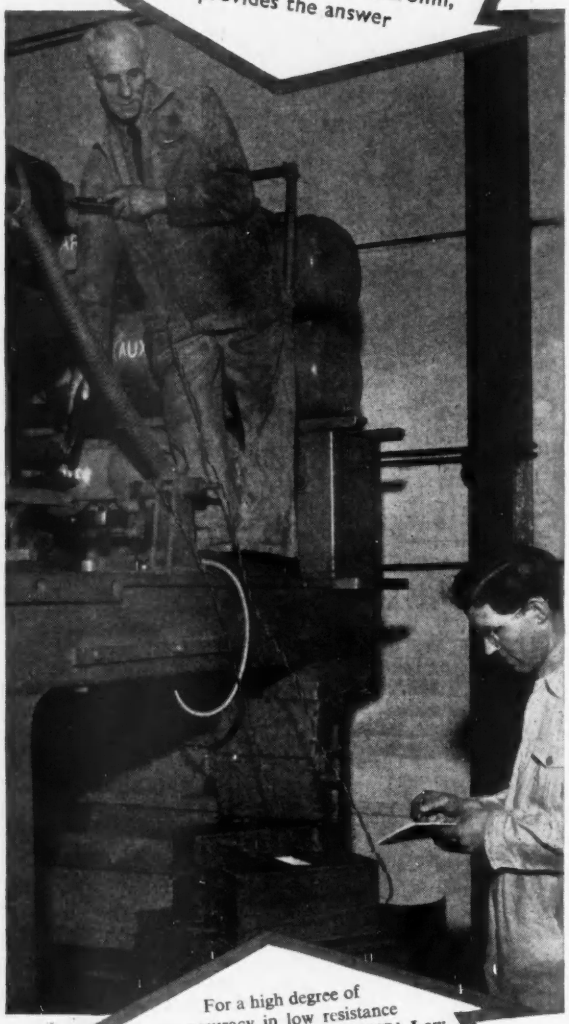

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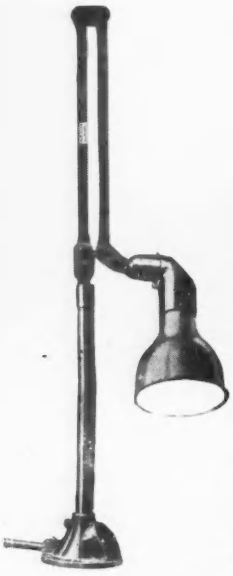

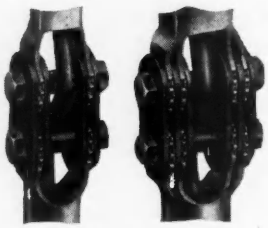

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Some Points about the Electricity Regulations

Part 6

By H. W. SWANN, O.B.E., D.F.H., M.I.E.E.

OPERATIONAL working was being discussed at the end of the last article in this series, which was concerned with Regulation 1 of the Electricity (Factories Act) Special Regulations 1908 and 1944. This Regulation requires that "all apparatus and conductors shall be sufficient in size and power for the work they are called upon to do, and so constructed, installed, protected, worked and maintained as to prevent danger so far as is reasonably practicable." Here it is the word "worked" that is under consideration.

Safe Working

Administratively this part, or word, of the regulation has been applied chiefly to cases where somebody fails to switch off before starting on a job of work. If, for instance, a maintenance electrician sets off to lubricate the trolley wheel collectors on a factory crane whilst the trolley wires are live, the offence would be that a switch controlling a supply of electrical energy to the conductors was not so worked as to prevent danger. It would as a rule be conceded that it was "reasonably practicable" to switch off the trolley conductors and in order to prevent this kind of accident, which is not uncommon, plant engineers would be well advised to label crane trolley switches and provide them with means of locking off. In a good many places this safeguard is supplemented by red warning lamps, and a permit to work system designed to prevent say a painter getting to work on the structure without telling the electrical department that he will be near the crane trolleys.

Switching Off

The obligation to switch off arises under many other conditions of work as for instance on switchboards. Engineers may take a chance by attempting a small adjustment or repair on a factory distribution switchboard, without interrupting the process by shutting down, a favourite job being to find out why a contactor is sticking. When I have examined some of the highly complicated and extensive contactor switchboards for controlling a modern rolling mill, or printing press, I have asked about this without always getting a satisfactory reply. When a contactor goes wrong the electrician may wish to energise the operating solenoid so that he can locate the trouble and make an adjustment, and thus the isolation required is twofold, so that the contactor loading circuit can be switched off independently of the actuating controls. Another aspect of isolation occurs when an experienced engineer puts the fuses of a motor control circuit in his pocket before doing a job of work on the motor.

When jobs on high voltage equipment arise attention to switching off is even more important because of the greater risk. Air-break pole operated isolating switches are not so common now as they used to be and, apart from their function, things have gone wrong on occasion whilst they were being "worked." The metal ferrule and hook at the end of the pole was sometimes too long and operators got the hook across phases when, owing to design or bad access, they could not get a straight pull. This was particularly true when three switches were mounted on the cubicle side wall instead of on the back. Again flashovers have occurred when the air break type of isolator has been used to break load current, or for that matter cable capacity current which I once tried to do. There was a long thin arc when I pulled out the blade to the full extent and after waiting for it to go out I pushed the blade back again. I was afterwards told that my second action was wise.

Check Test

It is usual to recommend that after isolating something for a job of work a check test should be made. Many engineers used to do this by attaching an earth wire to the hook end of the isolating pole and touching the isolated conductors with it. Some engineers may still be doing it this way and it is quite all right if no mistakes have been made in isolation. But it is just this that the test is meant to check and if there has been a mistake this method of test is another one and there have been a number of accidents, some of which have been fatal, when live high voltage conductors have been tested in this way. Again, when an isolator blade is open the top contact may remain live and it is most unwise to be pushing an earthed metal hook about in a cubicle under such conditions, or to try to make a permanent earth connection on the isolated side.

Where isolators are ganged and handle operated provision can be made for pulling them into earth contacts but it must, of course, be in two distinct stages, governed by a robost gate, so that an indicating test can be made between the two operations.

There can be little doubt that the best method of isolation is by way of physical separation, as achieved in truck type draw out switchgear or the same thing done in a vertical plane. The orifices exposed when the trucks, or circuit breakers, are drawn away should be covered by shutters which close automatically and are capable of being locked off in independent groups, e.g., where there are double busbars. Metal clad switchgear, which is the type usually associated with draw out or drop isolation of the circuit-breaker, introduces its own special problems when work is required on a section of the equipment as a whole as distinct from on the removable circuit-breaker. Accidents which have occurred at the spouts, ports or orifices, when engineers have tried to fix temporary earth wires have led to the use of earthing trucks, or some equivalent device special to particular designs of equipment. But if the isolating couplers, or interconnecting switches have not been "worked," or have been worked incorrectly the earthing truck is not an effective safeguard as it can be disrupted by the violent explosion which occurs when it is used and fatalities have been caused in this way.

The danger attaching to making tests after isolation by direct earthing has been recognised for years and there have been many suggestions for an indicating device, some of which have not been much better as regards the degree of risk. I recall being instructed to fit a number of glass tubes filled, I think, with CO_2 to a series of switch cells, connecting one side to the live conductors and the other to earth. They were intended for continuous operation and I had holes drilled in the cell doors through which they could be seen. The idea and intention were excellent but the tubes had so short a life that the scheme was dropped before the method of direct connection led to trouble. Later on, after I became an inspector, I visited a Government generating station of early vintage where, however, they liked to think they were marching with the times. They showed me an isolating pole on the end of which a glass gas-filled indicating tube had been mounted. It was about six inches long and a v.r.i. earth wire had been attached to the remote end and taped to the pole so that it would be grasped when in use. They demonstrated this whilst I stood clear in case the operator should miss his aim in the rather dark cell, and afterwards I offered the opinion that it was not unlikely that the back end of the tube might inadvertently be allowed to touch the live conductor. I thought it possible that the tube would glow sufficiently to be seen without the earth wire and, when the latter had been removed, I tried it myself and found that this was correct. The Chief Engineer (R.N. retired) was present and asked questions as to how the current obviously flowing through the tube was completing a circuit. I talked somewhat vaguely, perhaps, about capacity and micro-

amperes but in the event he reached the conclusion that the current must be flowing through me, and he objected most strongly to such a bad example being set by an officer of the Crown.

Mr Gerald Partridge was, I believe, the first engineer to make a condenser type of indicating stick. He had noticed that there always seemed to be a little blue spark when an ordinary isolating pole hook was approached to his open type wall-mounted airbreak 11 kV circuit-breakers at Deptford. He amplified the spark so that it could be both seen and heard by adding a simple condenser with a very large factor of safety. He became a strong supporter of its use, and he told me of a case where, as he put it, he had saved me a job.

The use of a live conductor detector involves two main considerations, firstly its ability to discriminate between a conductor directly connected to a source of power, and one which is only inductively coupled to that source or has a residual charge. The second and important consideration is that it should be inherently safe. In the days of the old C.E.B. I asked the late Sir Johnston Wright whether he could decide on the best type of detector for general use by his organisation and then standardise it for service. He remitted the matter to the E.R.A. and the latter in consultation with my old friend Mr G. F. Shotter produced a report* and as many industrial engineers are now concerned with high voltage equipment they may be interested to know something of the subsequent developments in supply practice.

Practical Indicators

Several different types of detector have been designed which incorporate a neon tube, or a voltmeter, whether of the electrostatic or series resistance type. Where there is no possibility of residual charge or of coupling indicators of the spark discharge and neon tube-types are satisfactory except perhaps, in bright sunshine, but where two overhead lines on industrial premises are carried on the same poles, coupling will generally occur and thus a quantitative indicator is desirable. The accompanying picture shows a detector designed for ranges up to 66 kV, in which a high series resistance is used in conjunction with a rectifier pattern moving coil instrument calibrated in kilovolts, which will give an approximate measurement of the voltage when the earth lead is grounded. A coupled or residually charged line will gradually discharge through the resistance giving a falling reading, which may stabilise at a value very much lower than that of the power line voltage, e.g., about 1 kV as against 6·6 kV, thus indicating that the line is in fact isolated and may be safely earthed. The instrument shown is manufactured by the Westminster Engineering Co., Ltd.

The instrument is actuated by the fall of potential across the last stage of the resistance at the earthy end and although this, and other types of detector, will function as indicators without an earth connection it is most desirable that the latter should always be used.

Some importance attaches to the method of scaling a small indicating instrument intended to discriminate, and that shown in the illustration is closed up at the higher reading so that lower voltages can be more clearly read.

Industrial applications of either the capacitor, or series resistance types, of detector may involve conditions which will cause deterioration of the bakelised paper employed for the construction of the rod. Whilst pure water may not cause much trouble, exposure to fumes or smoke may lead to a moist conducting film on the surface of the rod, and if the latter must be used in such places in wet weather, a direct connection to earth is recommended for attachment above the handle and separated from it by an insulating shield.

Before any form of detector is used it should be proved by trial on a conductor known to be live, or by means of a battery-operated induction coil. Makers usually provide a proving device in the kit, a convenient form being a buzzer-transformer-rectifier unit operating at about 1,000 V which buzzes to show it is working.

Another application of the live conductor detector lies in its use for phasing purposes. This involves either two detectors or alternatively an additional resistance, or capacitor rod from which the earth wire is connected to the indicator on the detector, the latter being earthed in the ordinary way. One rod is applied to each conductor and if phasing is correct the detector will show twice the indication normally obtained between one conductor and earth. Incorrect phasing will thus show as the normal indication only.

Permits to Work

The border line between operational working and jobs of repairs, cleaning, and such like, usually involves two separate departments in large organisations and out of this has grown the necessity for "permits to work." In electricity supply with central control rooms this will obviously entail a good deal of reliance on the clarity of telephoned instructions, and the same is true of work at distribution level involving the isolation of substations as a whole or in part. Many accidents have occurred as a result of mistaken instructions, mainly, I think, because messages are not read back, but partly at least because they are accepted instead of a permit. When a district engineer twenty miles from a control room, or a senior distribution engineer's office, is told to do some operational job of opening or closing switches, with perhaps the added work of testing and earthing, he is apt to go off and do it without observing the ritual of writing himself a permit. If he does, however, he often makes it as brief and cryptic as possible and thus misses the underlying purpose of a permit which is essentially to make those authorised to issue them sit down, think and then write out a full description of the operation, complete with identifications, dates, times and names of persons. Thus even if a district engineer has no one to instruct except himself he should make the system work by writing the permit properly, remembering that it may form an invaluable record. To a conscientious man the point will, of course, assume more importance when the safety of others is also involved and I think many will agree that the permit should define not only the job of work but also the sequence of switching operations required for its safe isolation.

Permits to work are, of course, used in other industries especially where there may be inflammable surroundings or toxic gases. When a factory electrical engineer is associated with a works of this character I have advised on occasion that electrical permits should line up in form and drill with the others rather than introduce a different method.

In connection with safe working generally and "permits" in particular, increasing importance attaches to line diagrams. These are often provided on an impressive scale in central supply control rooms but it tails off and I have watched and waited whilst a mains, or substation engineer has searched his drawers for a map or system diagram in order to assist my slow-moving intelligence. It has seemed to me that when he takes a telephone call from a central control engineer, surrounded by illuminated line diagrams, that he is perhaps at some disadvantage in following the details of what is being said over the telephone and the same thing may apply when he, in his turn, passes it on. On the other hand I have seen very good and comprehensive line diagram panels at some local offices and substations, a fact which underlines their omission in others.

An engineer in a central supply control room carries a high responsibility for safe working as well as for what we used to call "load despatching." The successful operation of a large electrical system is very much a matter of good team work in which the personality of the control engineer plays an important part. He has a statutory duty, in common with other persons employed, to conduct his work in accordance with the Regulations, and although it only gets a brief reference therein, I have tried to show that it is comprehensive.

Maintenance

The fact that the Regulations devote so little space to maintenance is most surprising in view of the importance of the subject. It is mentioned by just the one word in Regulation 1 which read with the context, denotes a requirement which may be expressed as "things shall be so *maintained* as to prevent danger if reasonably possible." The word is used again in Regulation 23 in connection with insulating stands but this time without qualifications, and thus one might assume that they have to be well *maintained* without regard to its being reasonably

**Electrical Research Association Technical Report reference F/T 133 by G. F. Shotter, M.I.E.E., and E. E. Hutchings, B.SC., M.I.E.E., 1940.*

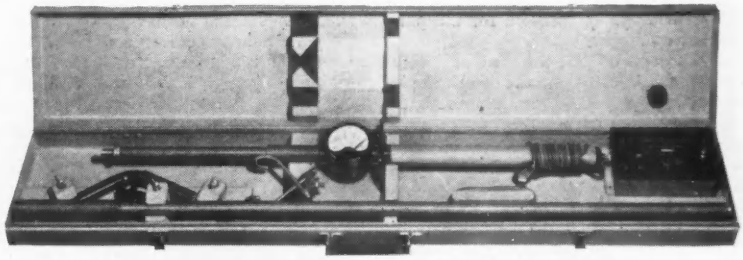
possible. In Regulation 3 we are told that a switch must be so constructed as to *maintain* good contact, and, in No. 4 so that an arc cannot be *maintained* but the sense in which the word is used is not the same as in No. 1, which must, I think, be taken as covering the whole field of electrical maintenance work.

I have cast back in an endeavour to remember when I first heard or learned anything about maintenance. It certainly was not during my training, or during the subsequent period when I was working at the bench in a factory, trying not to cut my hands so far as was reasonably possible. It must, I think, date from the first hour of the day when I arrived at a small steam driven generating station, in white overalls, and was told off to join a small gang who were working pretty near the bottom of the deep well, repairing the pump. I was nominally, I believe, on shift watch duties, but in those days, or at least at that place, we got the machines on load and after that the station superintendent, shift engineer, and switchboard attendant (which was me) went on to various jobs of repairs and overhauls leaving the driver to call us if anything seemed wrong with the running. I remember spending some days loading scrap into railway trucks, and putting coal on the fires when the shift stokers were unable to come in on Christmas evening, but apart from this, manual work of a mechanical or electrical character was continuous during the daytime shifts. I am told that in some of the B.E.A. divisions recruits go straight on to switchboard and control room duties and I think they are, perhaps, missing something if that is true, but times have changed.

Training for Maintenance

I have gone round a great many factories with plant engineers, electrical foremen and electricians of all ages and types. The common link between us was electrical working but hardly any two places were alike in its application and the fact is a tribute to the universal character of electrical service. It does, however, mean that any form of basic training for maintenance work must be limited to general principles, their application being developed in the particular industry or process in which a man gets a job. I do not know whether there is much subsequent interchange, that is, whether a maintenance engineer with ten years' experience in a motor car factory could expect to get an equivalent, or better, job in a flour mill or chemical works, but I should think his value is greatest in the factory where he has built up his experience. This, of course, is commonplace and there are many other factors which have a bearing on commercial value but I am in no doubt about the value, in terms of electrical safety, of an engineer who has been a long time in a factory and knows the process inside out.

A youth joining a large manufacturing organisation in these days may very well find that opportunities are afforded for both technical study and practical training in the work of the maintenance engineer. In places without their own training scheme there is a good chance of being allowed time off to attend a technical school but this is not quite the same thing because the latter have to provide a sound basic education which will serve as a foundation for many different specialised activities and maintenance work may not be singled out. A good many of the plant electrical men I have met have been "self made" that is, they have acquired learning as they worked and they certainly did seem to know all the answers.



Live line testing equipment including open-scale rectifier type m.c. voltmeter

A man working in a small factory, well away from large centres, becomes, I think, rather more self reliant than his brother in a large organisation, but his outlook and knowledge of electrical affairs is somewhat narrow although that does not seem to make him unhappy. I once visited a small public supply generating station where the owner had extended the main water turbine shaft to drive a grindstone and lathe through clutches and I wished I had one. It seemed to me, looking round, that he had made nearly everything himself, and I tried to break the regulations to him as gently as I could. In another very ancient place, with belt driven alternators, I found that the operating and maintenance engineer, who had been in the place all his life, transferred feeders from one machine to another as the load came up by taking the cable sockets off the studs at the back of the switchboard, lifting them along, and bolting them up again to the incoming machine. The characteristics of the system were 2,000 V, 100 cycles, single-phase, the place was spick and span, and he did everything from winding the belts to keeping the log in copperplate writing. He was happier about it than I was.

It is sometimes possible to get a useful line on the range and methods of the maintenance work in a factory by looking in at the engineers' workshop to see what sort of repairs are going on, the machine tools, stores and what testing instruments are available. Some of the fitters and electricians can be seen at work and there will be portable hand tools and lamp leads hanging on the walls. These places vary a lot from a cubby hatch to a really well equipped and orderly workshop and this in itself can be a measure of the relative importance attached by the management to maintenance work. If there are records, or log books, they usually repay study, especially if they relate to testing and periodic servicing as distinct from repairs after breakdown.

The stores contain samples of the fittings, components and electrical accessories and the engineer's experience of their use is always valuable. Conversely, he may have got hold of a type of fitting which has caused accidents and he welcomes information on the point, with mixed feelings. There is wide variation in the number and purpose of the instruments available in different places and I have made suggestions to the management about this because I believe testing is fundamental to good maintenance. Combined with records it can anticipate breakdowns and save both money and accidents.

I think the motor car industry must have been amongst the first to make large scale use of portable electric hand tools and accidents resulted from the practice of keeping every machine in use until it stopped. I wanted the maintenance people to take them out of service at regular intervals and to decide the period on a basis of what they found wrong. At the outset the failures were, in fact, so numerous that some managements went over to compressed air, but in every case, of which I know, where periodic testing was adopted electric hand tools gave satisfactory service.

Large scale use can justify adoption of the 3-phase hand tool working from a motor generator to give say 110 V, 100 cycles. This type of tool is robust and as the rotor is not wound there is no commutator with brushes and pigtails.

Testing Portable Tools

Some engineers who have instituted regular servicing prefer to have the tools brought into the stores for testing, overhaul and re-issue. In another case, where upwards of 900 hand tools were in use, a mobile testing rig was built up with arrangements for insulation measurement and heavy current test of the earth wire. This was pushed around the works and any tool found defective was taken out of service, the repairs being recorded under appropriate identification.

Heavy setting of the overload protective fuses, or other devices, is customary because the workpeople are not always kind to hand tools and do not like fuses which blow every time they stall a machine. This means that an earth fault can be destructive and it emphasises the importance of heavy current testing of the earth continuity path; for which

special instruments designed for the purpose are marketed.

It occurred to me, after investigating several fatalities, that the workpeople might wish, or could be persuaded, to test earth wires themselves and I suggested a test plate against which the tool could be pressed, with an ammeter and low voltage transformer, arranged as accompanying diagram, but I do not think the idea caught on. Continuously monitored systems are, however, used in conjunction with contactors of which the "hold in" coil is energised by a low voltage current circulating in the earth connections. If the earth continuity circuit is not maintained the contactor drops out and disconnects the machine and this principle can be applied in various ways. Alternatively, earth leakage circuit breakers, either of the voltage operated or current balance type may be used to supplement ordinary means of earthing and the various systems are discussed in some detail with six explanatory diagrams in Electrical Accidents 1951.*

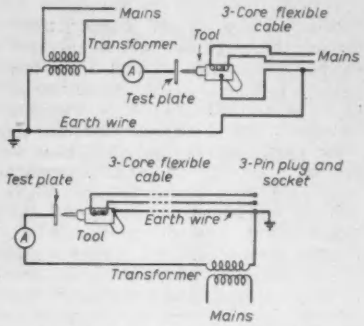
From the maintenance point of view these protective schemes add to the work because there is more to look after and if some form of radio interference suppression device has to be added also, the need of periodic testing is the more apparent. Thus engineers are turning more readily towards the relief of low voltage for portable hand tools, about which more later.

There is the widest variation in the conditions under which general maintenance work is carried on. A dye works introduces corrosion trouble, the fuse distribution boards in a flour mill may contain a little flour (I have seen some nearly full) and a central control room in an oil refinery, connected electrically to every part of the process, sets quite a lot of specialised maintenance problems. In many places there is also the complication of inflammable conditions but in all these multitudinous processes there are some basic matters which are, or could be, common.

Insulation Testing

Opinions differ as to the value of insulation testing as a means of anticipating breakdown of plant. I know of cases when, in conjunction with records, it has achieved conspicuous success in reducing stoppages caused by motor breakdowns. I know also of cases where a wet or damp or dusty process makes any such scheme difficult because the conditions are not consistent and leakage indicators are more to the purpose. Tong testers for checking loading against plant ratings and overload trip settings, save a lot of guesswork, and heavy current continuity testing of conduit, sheathing and earth wires are prolific in surprises. There used to be frequent accidents at motor controllers, mainly because the means of isolation was not individual, but design has improved and there is seldom justification for working on live gear.

When electrically driven machines were first used for coke ovens and blast furnaces they were mostly worked at about 200 to 250 V d.c. and there was no great difficulty with the insulators supporting the trolley conductors for the coke cars, rams and chargers running along the plant. With the introduction of three-phase a.c. at, say, from 400 to 500 V, screenwork often became necessary and made it difficult to clean the insulators. Some plants had a good many insulator



Alternative connections for a portable tool test-plate

failures and this led to the engineers taking the guards away so that they could find the duds quicker and effect renewals. I had to attend to one or two inquests and tried, without any success, to persuade the occupiers to revert to d.c. It became necessary to use insulators with much higher factors of safety and in the event it was found possible in many places to choose positions for the trolley conductors where they got some natural protection, so that less guarding was necessary. Maintenance work is however still awkward because these processes are continuous over long periods.

When I have talked to plant engineers about the test instruments available, and the possibility of using them to anticipate breakdown, I have had various answers and broadly speaking they fell into one or other of three categories. (1) No instruments had been provided by the management and anyway the plant was running all day so tests could not be taken, (2) any instrument required could be purchased and tests made during meal hours, evenings and week-ends or (in exceptional cases) at night, (3) the kind of troubles experiences, e.g., sticky trips, single phasing, dirty lighting fittings and damage were not matters in which testing would be of use.

The first view was that usually expressed in the smaller run of places, the second in the more modern and bigger places say with 1,500 motors or more, whilst the third came from the older men with such wide and lengthy experience that they knew where to look for the cause of almost any kind of trouble and also what equipment was likely to give trouble if not looked at. These opinions are all worthy of respect and it is up to associations, institutions, the technical press and inspectors to even them out and make the best of each.

In the more modern large scale plants much of the operation control is effected by automatic means. For instance, in blast furnace charging the whole cycle of operation can be started by pushing a button after which things happen by themselves in an ordered sequence. The skip acquires a measured load of ore, or coke, hoists it to the furnace top and after arranging for any necessary rotation of the latter, raises the bell, tips the load, closes down and returns to the bottom to get some more, rather on the lines of one of the late Mr H. G. Wells's stories. These movements are exactly synchronised with those of other automatically controlled equipment and it seems evident that unless the initial design and construction, together with the subsequent maintenance, of the various contactors, travel limit switches, and relays, reaches a high degree of reliability, things might get mixed up in a plant where it is necessary to keep say thirty blast furnaces going.

Operational Simplicity and Maintenance

It must have been about 25 years ago that I went over the control gear for a blast furnace skip hoist, where there had been an accident to an electrician who told me that the travel limit switches (fixed outside and not on the winding drums) went wrong so often that it was hardly worth while coming down in between repair jobs. There was a driver for each hoist and although the automatic gear could not have been extensive it did seem to be giving trouble as a result of exposure to weather, fumes and grit. I suggested an isolating transformer to reduce from 400/230 to 110 V for the external switches and later learned that the failures had been lessened and maintenance work reduced. Industrial control equipment has been greatly improved since those days but the present day complication accepted in order to make the driver's job as simple as possible, by confining it to pressing a button, needs justification in terms of a saving in the number of operators required, or speeding of the process, which must not be off-set by addition to the maintenance personnel.

I have had the considerable advantage of discussing this point with representatives of an eminent consulting organisation possessing years of experience of a plant where some 6,000 electric motors of all sizes are required. The view is expressed that automatic operation has resulted in a marked reduction in the number of attendants and although the complexity of the equipment is recognised the additions to the maintenance staff required to keep it in order does not neutralise the economies achieved in operation to any appreciable extent. It has however been necessary to put the maintenance work on a highly organised basis of which the underlying aim is to anticipate trouble before it occurs. I plan to discuss this point further in the next article in this series.

(To be continued).

* Electrical Accidents and their Causes. Form 929, Published for the Factory Department M. of L. and N.S., by H.M. Stationery Office, 3s. net.

Successful installation in a Liverpool cafeteria where an even distribution of light was attained despite the large expanse of white undecorated ceiling

Large Ceiling Recess presents Lighting Problem

NEW lighting installations are such frequent events that only a few are really notable. We therefore endeavour to select those which possess some unusual feature or present some particular difficulty to the illuminating engineer. One such installation was in the new cafeteria at Lewis's Ltd. in Liverpool, where the problem lay in the design of the ceiling. There was a central recess measuring some 30 ft by 60 ft and about 3 ft in height with a dark surround, which made even illumination difficult.

To overcome the likelihood of areas of high brightness near tubes in the surrounds and low brightness in the centre, the vertical surfaces were painted a matt dark green to lower the reflectance, and specially designed fluorescent fittings installed in the surrounds. In addition a special George Forrest feature comprising a number of 60 W lamps in small metal spinnings on an open trellis frame, was installed to provide downward direct lighting. This also broke up the large expanse of undecorated white ceiling. The dark surround has been broken only by a single row of special 100 W fittings. In the servery, specular reflection from the surface of a contemporay motif executed in glazed tiling, has been avoided by providing indirect illumination only.

All the fittings in this installation were supplied by Thorn Electrical Industries Ltd., who were also lighting consultants to the scheme.

CABMA REGISTER

THE latest and improved edition of the CABMA Register for 1954-55 has been published by Kelly's Directories Ltd. and Iliffe and Sons Ltd. This volume was first published last year to meet the demand for a comprehensive reference book for Canadian companies concerned with U.K.-Canadian trade. Once again the book includes a Buyer's Guide, directory of Manufacturers and Distributors, and lists of Proprietary Names and Trade Marks. This invaluable volume retails at 42s. (44s. by post).

Doctor in the House used "Egg" for Lighting

ONE of the most extraordinary cases ever heard in this court, was the description given to a case in which a doctor was accused of maliciously using electricity belonging to the N.W. Electricity Board. At Westmorland county court recently, the prosecution stated that the supply had been cut off because of non-payment of an account and that the doctor had reconnected. The doctor, who pleaded not guilty, countered by admitting that a light could have been seen in his house after supplies had been cut, but said that power was supplied at 120 V by an experimental thing called an egg which had been lent to him. It generated electricity by nuclear fission, and was a noiseless non-mechanical apparatus. He refused to say where the egg was or who owned it. The prosecution then stated that if 120 V d.c. had passed through the a.c. meter the coil in it would have been burnt out. The jury found the case proved, and the doctor was fined £50.

Possibility of Pollution halts Housing Scheme

COMPLAINTS about the allegedly serious pollution of the air from the chimneys of Dunston power station have been frequent, but it now appears likely that criticism will be levelled against the North and South Stella power stations which have yet to be completed. Reason is that, according to reports from Newcastle, Newburn council have been advised by the Ministry of Housing not to proceed with the building of about 150 houses in the neighbourhood of the stations until several years' experience of the stations' effects on the district has been obtained. Despite the fact that the four new chimneys will be some of the tallest in the country and the most modern extractors to be installed are estimated to take 98% of pollution from the atmosphere, the power stations may be the cause of severe atmospheric pollution, it was stated.

SPORTS MEETINGS

THIS is the season for sports days though we trust the present sample of weather has not been too detrimental. None of the competitors seems to have been badly deterred. Kidbrooke saw the sports meetings of Johnson and Phillips and Telcon sports clubs and a meeting of the two at sack-football resulted in a win for the former. Many Northern football clubs would be very pleased with the gate of 10,000 which attended Metrovick's sports and gala day, held for the first time this year in their Apprentice Training School grounds. Events were open to all in the A.E.I. Group and contestants numbered over 400. In Manchester, too, was the annual meeting between British Driver Harris and Ripaults of Enfield. Although away from home this year, the southern company retained the coveted Parry-Roberts Trophy.

NEWS IN BRIEF

Bristol has opened a fund to raise £10,000 to cover the costs of accommodating the annual meeting of the British Association for the Advancement of Science to be held in the city next year from 31 Aug. to 7 Sept.

Newly - formed Brazilian Exporters' Association is to send delegation to Britain to discuss ways of stimulating Anglo-Brazilian trade.

First of a new series of Action pamphlets entitled "Why Productivity?" has been published by the British Productivity Council. It states clearly and concisely the case for raising productivity.

Programme of the repeated course on Work Simplification to be held at Roffey Park Institute, Horsham, from 27 Sept. to 1 Oct., has been issued.

Further financial support is to be given by the Government for the strengthening and expansion of the Manchester College of Technology.

Brush Group's tenth management meeting for foremen was held at the Loughborough works. Nearly 40 attended.

Fifth annual residential summer school of the Institute of Cost and Works Accountants will be held at St. Catherine's College, Cambridge, from 20 to 25 Sept.

Fires involving electrical appliances in Manchester last year numbered 163.

Commercial Electric Co., Ltd., hold a provisional patent on meter cubicles or housings, which form a part of the wall of a house and can be read easily from the outside of the building by inspectors and meter readers.

An appeal for reconsideration of the Yorkshire Electricity Board's tariffs as they apply to churches has been made by Mr G. Hirst, M.P. for Shipley.

QUESTIONS IN PARLIAMENT

Scottish Reorganisation

THE Electricity Reorganisation (Scotland) Bill was read a third time and passed, in the Commons last Monday. By far the most important event in the debate was the exclusion of clauses 4 and 5 in the original Bill which provided for the establishment of two executives in the one Board to cover each of the two previous administrative areas. The amendment was moved by Mr J. Stuart who recalled the fears that in practice there would be three bodies dealing with generation and supply in southern Scotland. He said the Government was prepared to leave it to the Board to advise on the structure which would ensure the most suitable administration. The amendment would, he said, leave the Board to make its own arrangements and modifications without formal approach to the Secretary of State. The amendment was agreed and the Secretary of State said later that in appointing members of the new Board the same principles would operate as exist now in the case of the N. of Scotland H.E. Board.

Charges to Churches

IN a written answer last week Mr L. W. Joynson-Hicks refused to agree to a suggestion by Mr G. Craddock that churches should no longer be charged on the standard commercial tariff for electricity consumption. He said that the majority of Area Boards had arrangements for churches based on the special nature of their use of electricity, so that those premises usually paid less than if they were charged as commercial undertakings.

U.K. Trade with Spain . . .

OUR trading relationships with a number of countries were mentioned in a series of questions last Wednesday, the traditional day for dealing with trade and commerce. Sir L. Ropner asked for some details of the recent talks with Spain. He was told that current arrangements governing Anglo-Spanish trade and payments were working satisfactorily. This applied particularly as regards "less-essential" goods.

. . . and China

IN view of the recent visit of the Chinese trade delegation Messrs Beswick and H. Davies enquired as to the steps being taken by the Government to meet the mission and discover the needs of China. Mr D. Heathcoat Amory said that senior officials of the Board of Trade and Ministry of Supply had already met the delegation informally. The visitors were touring factories and would meet trade associations and manufacturers, and it was hoped this would result in an expansion of trade in non-strategic goods.

London-Tilbury Electrification

TECHNICAL planning for the electrification of the London to Tilbury railway line was well in hand, Mr Lennox-Boyd informed Mr A. Parker. Plans for the engineering works at Barking were nearly complete, but those and other preliminary works had to precede the electrification proper. He warned that they would take some years to complete, although some had already been started.

Minister in Canada

IN the absence of the President of the Board of Trade, Mr D. Heathcoat Amory gave a short review of the President's recent visit to Canada, in reply to a question by Mr A. F. Holt. While in the Dominion he emphasised that U.K. purchases from dollar countries, and from Canada particularly, would increase if Canada bought more from Britain. The U.K. was now offering goods competitive in price, in quality, in delivery and in after-sales service, in nearly the entire range of Canadian imports. There appeared to be a keen desire on the Canadians' part to buy from this country.

Supplies to Welsh Farms

SOME figures on the number of farm holdings in Wales supplied with electricity were given by Sir T. Dugdale in reply to Mr T. Watkins' question. County figures were not available but Sir Thomas said that in the whole of Wales just over 90% of holdings had a supply at the time of the National Farm Survey 1941-43. On 31 Mar. last the figure was 26·5%. Comparable figures for England were 27% and 59·5% respectively.

ELECTRIC SUPPLY NEWS

Altnabreac

Preliminary work has begun on the peat utilisation scheme at Altnabreac of the North of Scotland Hydro-Electric Board. Heavy earth moving equipment has arrived on the site, and in the first development 40 miles of ditching will be done. The peat eventually produced is to be utilised in a local power station with gas turbine plant, proposals for which were referred to in our 18 Feb. issue.

Huddersfield

A conference is to be held to consider the objections of Huddersfield Corporation to a scheme of the B.E.A. to establish a new power station at Elland, under which it is proposed to obtain cooling water for the station from the River Calder and after heating to return it to the river to be passed downstream to Brighouse. The Corporation's objections have been considered by the Ministry of Fuel and Power which has decided that they could be dealt with when the B.E.A. makes formal application to the Yorkshire Ouse River Board for consent to open a new outlet into the River Calder. The River Board, which has already been asked by the Corporation to consider their objections, has suggested that a conference should be held between representatives of the Corporation, the Mill Owners' Association, the fishery interests and the Board.

N. of Scotland

The Shin hydro-electric scheme is a portent of happier days, declared Mr Thomas Johnston, Chairman of the North of Scotland Hydro-Electric Board, at the inauguration of work on the scheme last week. Side by side with the provision of electricity there was a promise of considerable forestry operations in Strathoykell and elsewhere in Sutherland.

The Shin scheme, Mr Johnson added, would save the country the equivalent of 90,000 tons of coal a year and produce sufficient electricity to serve all Sutherland, all Ross, and all Caithness counties. For five or seven years there would be full employment there. The farm workers' wives and daughters would have power, light, and amenity, and less inducement to quit the country for the city. There would be more attractions for the tourist trade, and if the experience of Argyll county went for anything there would be an association of electrical power with timber processing. Miss Jessie Murray, a crofter's daughter, set off the first explosive charges on the dam site.

Turton

The U.D.C. has apparently again changed its mind regarding the route of the proposed 275 kV transmission line through the Turton district. It is now suggested that the Yorkshire border-Penwortham line should follow a westward route across the north end of Jumbles valley and then north-west along an alternative route which was originally proposed by the Council's engineer and surveyor, to the old Turton Moor pipe works. But if the B.E.A. does not agree to these proposals, then the U.D.C. will raise no objecton to the power line passing east of Bolton and north of Darwen, in accordance with the suggestion put forward to the Bolton Corporation.

LIGHTING SCHEMES

Ramsey. The Town Board has approved a new lighting scheme for the town.

Rowley Regis. The T.C. is seeking to borrow £4,070 in respect of the proposed electric lighting at Dudley Rd, Tividale.

Rushden. U.D.C. to prepare a scheme for re-lighting a portion of A.6, comprising High St South and Bedford Rd.

COMPANY ACTIVITIES

THE 1953 report of the Oriental Telephone and Electric Co. tells the story which is becoming common these days. It is the story of the company which has done valuable pioneer work in installing telephone systems and other electrical apparatus in far away countries, only to find, with the development of the local people, that their organisations are wanted by the local Government. In the case of Oriental, the latest report shows that the Government in Singapore has taken over the Singaport Telephone Group as from 1 Jan., 1955. The company's Jahore Bahru undertaking will be taken over by the Government of the Federation of Malaya on the same date. The company's interest in subsidiaries now consists in an interest in Rangoon Telephone (in voluntary liquidation) and the whole of the issued capital of China and Japan Telephone and Electric Co. Nobody can quarrel with the aims and aspirations of the Asiatic peoples, but so often these changes mean a loss of export orders for equipment, etc. It is up to our exporters to get on to the new controllers as quickly as possible.

Throughout the world quality pays, and tremendous success is attending the export efforts of the Dictaphone Co., chairman of which is Mr C. King Woodbridge. He attributes the success of his world-wide business, which includes the Dictaphone Corpn., New York, with the fact that in 66 years' experience in the manufacture of dictation machines, "we have never compromised with quality."

As a result he was able to tell shareholders that the company found itself today in the strongest competitive position it has ever enjoyed. While all departments have shown substantial increases, exports are worthy of particular comment. They amounted to no less than 69% of total production and in 1954 to date export business accounts for an ever higher percentage of sales. Products bearing the Dictaphone trade mark are being actively sold in more than 70 countries. Sales for the first six months of this year indicate an additional sales increase of nearly 30% for the full year—a good example of expansion resulting from drive and enterprise.—*From our City Correspondent.*

Drake and Gorham Ltd.

The considerable increase in the profit for the past year (shown in our table) is to a large extent due to the inclusion of profit from some big contracts which were almost completed in the previous year. Mr R. H. M. Drake, chairman and joint managing director, warns that it is

Year to Mar. 31	£ Trading Profit	£ Net Profit	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1952	82,325	19,026	25	5	—	—
1953	55,110	9,725	9	5	—	—
1954	108,258	28,468	36	7½	—	—

probable that the profits for next year will not be so high in spite of the fact that there is a considerable amount of work in hand and orders are coming in satisfactorily. The board has continued its policy of expanding its overseas work and arrangements are in hand which will make it possible to carry out large contracts in West Africa and the Federation of the Rhodesias and Nyasaland.

Electric and General Investment Co.

The dividend is 10% on the doubled capital, against 15% last time. Net profit for the year to 31 May last is £13,961 (*£10,684*).

Electric Construction Co. Ltd.

A record in production and turnover was achieved by this concern during the past year—approximately one-third being for export. Despite increasing world competition, the orders in hand are being maintained at a satisfactory level, Mr C. Reid, the chairman, states. In regard to the subsidiaries, the Tyseley Foundry has again had a satisfactory year, and the factory in South Africa will be in production at an early date, he explains. Through the associated company in Canada, it is hoped to receive large orders in due course.

Year to Mar. 31	£ Trading Profit	£ Net Profit	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1950	475,263	116,027	62	15	62/6	43/6
1951	506,816	100,680	54	15	72/–	55/–
1952	535,930	99,220	53	15	57/–	42/6
1953	552,526	93,628	44	15	56/–	50/6
1954	566,535	109,258	42	15	61/–	53/–

W. T. French and Son Ltd.

This company, the Ordinary Shares of which are now held by Warne, Wright and Rowland Ltd., made a loss of £30,668 in 1953. Air Commodore J. A. Cecil-Wright, the chairman, refers to a complete reorganisation of production involving redesigning and improving the domestic appliances. As a result, orders being received are now in excess of manufacturing capacity, he states.

Lightfoot Refrigeration Co. Ltd.

During the latter part of 1953 there was a falling off in home orders for commercial and industrial refrigeration plant. But the value of refrigerating plant of all kinds delivered and invoiced during 1953 showed an increase on the preceding year. Of this, more than 50% was exported, and it had the effect of reducing the company's total profit on sales of machinery, as the margin obtainable on export orders is, to a large extent, limited by international competition, Mr C. P. N. Raikes, the chairman, explains. The volume of unexecuted orders brought into 1954 was substantially less than those carried into 1953.

Marryat and Scott Holdings Ltd.

The decline in the trading profit is due to the non-completion within the past year of a number of lift installations because of the unfinished state of the buildings which they have been built to serve, Mr Murray D. Scott, the chairman, explains. Actually, the volume of orders secured during the twelve months to 31

Year to Mar. 31	£ Trading Profit	£ Net Profit	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1951	92,978	39,013	61	22½	6/7	5/–
1952	113,117	37,088	58	22½	5/10	5/1
1953	140,170	50,382	70	22½	6/3	5/1
1954	129,583	67,119	77	25	7/–	5/2

Mar. last, was the highest and most valuable in the company's history. Extensions are to be carried out at the works and offices at Hounslow. Marryat and Place Ltd. also achieved a record in their electrical contracting, maintenance and manufacturing activities.

Morgan Crucible Co. Ltd.

The sales turnover during the past year was appreciably less than in 1952/53, but the fall in foreign business was relatively less than in home sales, Mr P. Lindsay, the chairman, states. But the order book

Year to Mar. 31	£ Trading Profit	£ Net Profit*	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1950	1,310,626	461,305	30	12½	52/6	48/8
1951	1,738,184	533,738	37	12½	57/6	46/9
1952	2,290,410	770,971	55	12½	49/–	42/–
1953	1,826,576	673,024	41	12½	50/6	44/9
1954	1,904,038	640,281	40	14	57/3	46/6

*Available for parent company

has a healthier colour than at the corresponding period last year, he adds. It is proposed to make a more even division between the interim and final dividends in future.

Phoenix Telephone and Electric Co.

The dividend is raised by 5% to 15%, for the year to 28 Feb. last. Consolidated net profit, after tax, is £54,483.

Sayings OF THE WEEK

"The right way to start a national fuel policy is not by dictating to the housewife whether she can use an electric iron or not, or can use it at a particular time or not, or whether she must use a gas fire instead of an electric fire. That is the wrong end to start a policy." . . . MR JOYNSON-HICKS in the House of Commons.

"If we have to await the accretions of output from capital works before there is a pronounced increased output (of coal) we shall have one or two anxious winters to meet after this one." . . . SIR HUBERT HOULDSWORTH, Chairman of the National Coal Board.

"The Highlands have had enough and to spare of prophets of woe and lamentation." . . . MR THOMAS JOHNSTON, chairman of the North of Scotland Hydro-Electric Board, speaking at Lairg.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

16 July—Slough T.C. Submersible electrically driven pumping unit.—See 8 July issue.

17 July—Wilmslow U.D.C. Erection of class B concrete columns and lighting fittings in Hollin Lane, Styal. Names by above date to Engineer and Surveyor, Council Offices, Green Hall. Deposit £2. 2s.

19 July—Lancashire. Electrical installation at Liverpool I.M. Marsh College of Physical Education. Names to County Architect, P.O. Box 26, County Hall, Preston, by above date.

19 July—Liverpool. Rewiring at Sefton General Hospital.—See 8 July issue.

19 July—Manchester T.C. Installation at Park Hall, Thurloe St.—Advertised in 1 July issue.

19 July—Midlothian. Concrete columns, lamps, lanterns and fittings at Newtongrange.—See 8 July issue.

19 July—Oldham T.C. Columns and lanterns for group A street lighting.—Advertised in 1 July issue.

19 July—Southend-on-Sea T.C. Installation in West Leigh school.—See 1 July issue.

19 July—West Riding. Installation at Thorne grammar school.—See 8 July issue.

20 July—Birtley (Dur.) P.C. Supply and erection of mercury vapour units in Durham Rd. S. Hunt, clerk to council, Council Chambers, The Grove.

20 July—Epping U.D.C. Installation of electricity in 20 houses.—Advertised in 10 June issue.

21 July—Chadderton U.D.C. Lanterns, transformers, capacitors and time switches etc.—Advertised in 8 July issue.

21 July—Crosby T.C. Class A street lighting at Seaforth.—See 8 July issue.

21 July—Wandsworth B.C. Concrete columns, etc., for group A street lighting. Also, sodium lamps and jackets.—Advertised in 8 July issue.

22 July—Harwick T.C. Installation in 23 blocks of houses in Burnfoot and Burnhead scheme.—See 8 July issue.

22 July—Maidenhead T.C. Erection of concrete columns; fixing fluorescent lanterns and auxiliary gear; and wiring.—See 8 July issue.

23 July—Lichfield (Staffs). Supply of lamps and fluorescent tubes to Lichfield, Sutton Coldfield and Tamworth Hospital Management Committee. Secretary, 15 Trent Valley Rd, Lichfield.

23 July—Sunderland T.C. Installation in Hylton Red Hse, school.—See 8 July issue.

24 July—Inverness. Electrical installation in 34 houses being built at Drumnadrochit. County Architect, The Castle.

24 July—Peterborough T.C. Lighting and power installations in 80 flats (10 blocks) on Dogsthorpe North estate. Applications by above date to F. J. Smith, City Engineer and Surveyor, Town Hall. Deposit £2. 2s.—Advertised in this issue.

24 July—Seaton Valley U.D.C. Installation of electricity, instead of gas, in 225 houses at Seghill. Surveyor, Council Offices, Seaton Deleval.

24 July—Southport T.C. Installation of electric lighting and heating in 54 houses on Radnor Drive estate. Borough Architect's Dept, 93-105 Lord St. Deposit £1. 1s.

26 July—Leeds. Electrical services in twin operating theatre unit at County Hospital, York.—See June 17 issue.

27 July—Clackmannan. Columns, sodium lanterns with control gear, etc., for relighting trunk road A19.—See 8 July issue.

28 July—Ilford T.C. Plant and equipment, for Roden St sewage pumping station.—Advertised in 24 June issue.

29 July—Belfast T.C. One 4-ton mobile crane at Power Station in West.—Advertised in 8 July issue.

30 July—Blackburn R.D.C. Supply and erection of electrically operated pumping plant in duplicate for part 2 of Eccleshill sewerage scheme. Council's consulting engineer, Arnold Brooksbank, 14 The Exchange, Bradford. Deposit £2. 2s.

30 July—Taunton T.C. Sewage and storm water pumping plant, etc.—See 10 June issue.

31 July—Belfast. Installation in St. Patrick's Training School.—See 1 July issue.

5 Aug.—Belfast T.C. Installation in bakery school.—See 8 July issue.

5 Aug.—Kingston-on-Hull T.C. Light and power installation at Thanet county primary school infants' dept. City Architect. Deposit £1. 1s.

5 Aug.—Southampton T.C. Electrical installation in Harefield junior and infants' school. Borough Architects, Civic Centre. Deposit £5.—Advertised in this issue.

6 Aug.—Heckmondwike U.D.C. Electrical installation in old people's dwellings in Strawberry Sq. Council's Surveyor and Engineer, Oldfield Lane. Deposit £2. 2s.

7 Aug.—Pwllheli T.C. Installation for auditorium of Town Hall.—Advertised in 8 July issue.

9 Aug.—Kidderminster T.C. Lighting and power installations, in the Retail Market, High St.—Advertised in 8 July issue.

13 Aug.—Co. Tyrone. Installation at Dungannon secondary intermediate schools.—See 8 July issue.

16 Aug.—Denton U.D.C. Supply of street lighting conversion units for attachment to existing gas columns. Units to be wired, with lantern bracket and time switch, etc. Engineer and Surveyor, Town Hall. Deposit £2. 2s.

16 Aug.—Manchester T.C. Electrical installation at Poundswick grammar school, Wythenshawe. City Architect, Town Hall. Deposit £1. 1s. Advertised in this issue.

19 Aug.—Belfast T.C. Boiler feed pumps for first extension of Power Station West.—Advertised in 1 July issue.

25 Aug.—Wandsworth B.C. Repair of about 700 synchronous solar dial electric time switches. Borough Engineer, Municipal Bldgs, S.W.18.—Advertised in this issue.

27 Aug.—Leeds T.C. Electrically-driven multi-stage centrifugal pumps with electric motor and switchgear.—See 8 July issue.

No date stated—Aberdeenshire. Installation of electricity at Oldwhat, Bonnykelly, Drumwhindle, Auchedly and Eddiston schools. County Architect's Dept, 25 Union Terrace, Aberdeen.

No date stated — Malden and Coombe (Sur.) T.C. Supply and erection of 20 street lamps for group B tungsten filament lighting in Beverley Way, Beverley Lane and Coombe Hill Rd. J. Apse, Borough Engineer, Municipal Offices, New Malden.

No date stated—Preston T.C. Electrical installation in Gammull Lane hostel, Ribbleton. Apply to Borough Engineer and Surveyor, Municipal Bldg.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources including an index of trade information with over 100,000 entries

A Selection from the 112 queries answered this week

"Triumph Superb" potato peeler, makers of? F.W.H.—Davy Machine Co., 8 Admiral St, Dewsbury Rd, Leeds, 11.

Tartan Mfg. Co., Ltd., makers of "Tartan" drills, address of? M.E.B.—Wooburn Green, High Wycombe, Bucks.

Rotary chasing machine shown at the Building Plant Exhibition and on television, suppliers of? G.R.M.—This refers to the "Rapid Mate" supplied by Adam and Harvey (Rapid Hammer) Ltd., 10/13 Newgate St, E.C.1.

"Timlec" clocks, repairs of? MeN.W.—Comer Electrical Repair Service, 23 Bridge St, Taunton, Somerset.

Sewing machine motors marked Universal with no trade name, makers of? T.B.C.—Sew-tric Ltd., Honeypot Lane, Stanmore, Middlesex; Hillman Electrical Ltd., 2 Northwold Bldgs., Northwold Rd, N.16.

"F.E.W. Clip-on" handlamps, makers of? A.B.L.—C. M. Churchouse Ltd., Clarendon Works, Clarendon Rd, W.11.

Ceiling switches with indicator lamps, makers of? T.E.—Britmac Electrical Co., Ltd., 121 Victoria St, S.W.1.

. . . and Overseas

Details of items marked • may be obtained on application to the Board of Trade, Lacon House, Theobalds Rd, W.C.1, quoting reference.

27 July—U.S.A. Construction of Pickstown Electric Supply Line in Sth Dakota. Work includes removal and re-use of present line; erection of 3,750 lin. ft. of 3-phase 2,400 V line and 3,500 lin. ft. of single-phase line; transformer station; voltage regulator; erection of underground electrical circuits etc. Invitation No. CIV-ENG-25-066-54-199. Documents from District Engineer, Omaha District, Corps of Engineers, 1709 Jackson St, Omaha, Nebraska. B.o.T. (Ref.: ESB. 16730/54).*

29 July—India. Supply of three diesel engines directly coupled to 300 kW (3,300 V 3-phase 50 c/s a.c. generators, with three generator control panels, one synchronising panel and two feeder panels. Tender No. B/1(c)/134/A. Govt. of India, India Supply Mission, 2536 Massachusetts Ave, N.W., Washington 8, D.C. B.o.T. (Ref.: ESB 16484/54).*

23 Aug.—Formosa. Supply of 33 kV outdoor equipment, switchboard, six power transformers, three power condensers, and co-ordinated drive system. Invitation No. 295-D. Central Trust of China, U.S. Aid Div., 96 Po Ai Rd, Taipei, Taiwan. B.o.T. (Ref.: ESB 16822/54).*

3 Aug.—Australia. Electricity Trust of S. Australia invites tenders (No. 649) for supply of 27 33,000/11,000 V Delta/Star 3-phase transformers. B.o.T. Ref.: ESB 15844/54)*

3 Aug.—Australia. Supply of main power switchboard of unit type built of fabricated sheet steel. Supply is a.c. 50 c/s 3-phase four wire M.E.N. 400/230 V. Ten der No. 531. Dept. of Works, Melbourne. B.o.T. (Ref.: ESB 16006/54).*

3 Aug.—Australia. S. Australian Railway inviting tenders No. 5041 for supply of 26 diesel engines, transmissions, control equipment, etc. Secretary of Railways Commission, Adelaide. B.o.T. (Ref.: ESB 16008/54)*

4 Aug.—South Africa. Supply of 25-line Private Automatic Exchange and iron clad telephones for Stores Dept., S. African Railways, P.O. Box 8617, Johannesburg Tender No. C.7986. B.o.T. (Ref.: ESB 16379/54)*

9 Aug.—Formosa. Supply of amplifier and speaker sets, telephone equipment, electric arc welding machines, welding transformers. Invitation No. 299A. Central Trust of China, U.S. Aid Div., 96 Po Ai Rd, Taipei, Taiwan. B.o.T. (Ref.: ESB 16524/54)*

10 Aug.—Brazil. Supply of ten diesel driven generators of 500 kW each for Comissao Estadual De Energia Electrica, Porto Alegre. B.oT. (Ref.: ESB 16800/54).*

17 Aug.—Uruguay. Supply (under tender No. 2284) of 8,000 insulators for main voltage of 6 kV and 15 kV (4.000 each) between phases. Guarantee of U.R. $1,200 required. Administracion General de las Usinas Electricas y los Telefonos del Estado. B.o.T. (Ref.: ESB 16019/54).

13 Sept.—Tangier. Water and Electricity Supply Board requires supply of wooden poles to carry supply lines, and eight transformers of 5,500/200/115 V. B.o.T. (Ref.: ESB 16503/54)*

15 Sept. — Australia. Supply, erection, etc., of engine driven electrical generating plant for Balonne Shire Council. Tender No. 453. Documents from Agent-General for Queensland, 409/10 Strand, W.C.2, at £2 2s.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, 13 July

	£ per ton	Weekly change £	Price last year £
COPPER, standard class A (settlement)	239½	−½	252
„ (3 months)	237½	−½	—
LEAD, refined pig. min. 99·97% purity (cash)	96½	−½	90½
„ (3 months)	94½	−½	88
TIN, refined, min. 99·75% purity (settlement)	759	+1	596½
„ (3 months)	749	+2	596½
ALUMINIUM, ingots 99-99·5%	156	—	150
ZINC, virgin, min. 98% purity (cash)	78	−¼	73
„ (3 months)	78¼	−1	73½
RUBBER No 1, RSS. spot (per lb.)	21½d.	−1/16d.	19½d.
„ c.i.f. basis, ports. Sept. (per lb.)	21d.	−1/16d.	19½d.
ARMOURING:			
Galv. Steel Wire (0·104 in.)	52	—	50½
Mild Steel Tape (0·014 in.)	40½	—	40

Gazette Announcements

COMPANIES ACTS

Brocks Refrigeration Ltd. Petition for winding-up presented on 5 July and directed to be heard at Royal Courts of Justice, on 19 July. Interested parties should communicate with Wilde Sapte and Co., 74 Gloucester Place, W.1, by 17 July.

Almag Engineering Co., Ltd. At meeting on 30 June resolution passed for voluntary winding-up. E. R. Nicholson, 11 Ironmonger Lane, E.C.2, was appointed liquidator.

Metallizing and Engineering Co., Ltd. W. M. Ogle, Gresham Hse, 24 Old Broad St, E.C.2, has been appointed liquidator by members.

W.E.K. (Electrical) Ltd. Liquidator appointed is Torquil John Murdoch Macleod of 4 Bucklersbury, London, E.C.4.

National Telewriter Co., Ltd. Resolution for voluntary winding-up passed at meeting on 22 June when G. C. Hollowell, C.A., 5 Throgmorton Ave, E.C.3, was appointed liquidator.

Bingley Refrigeration Services Ltd. Meetings of creditors and members are to be held at office of Thomas Gardner and Co., Cheapside Chambers, 23 Cheapside, Bradford, on 10 Aug. at 10.45 a.m. and 10.30 a.m. respectively.

BANKRUPTCY ACTS

Public Examination

Wigan. Frank Robinson, electrical contractor trading at 78 Scholes, and 112 Frog Lane, Wigan. Public exam will be at The Court Hse, Crawford St, Wigan, to-day (Thurs) at 10 a.m. First meeting was held on Tues.

Intended Dividends

Leicester. Thomas G. Coaton, electrical engineer trading as T. G. Coaton and Co., at 16 Humberstone Rd, Leicester. Last day for receiving proofs, 21 July. Trustee is E. C. Stimpson, Official Receiver, 27 Regent St, Park Row, Nottingham.

Kingston-on-Hull. Harry G. Willingham and Henry Baxter, trading as Star Ventilation Co. at 6-12 Commercial Rd, Hull. Last day for receiving proofs, 24 July. Trustee is S. D. Moore, 4 Silver St, Hull.

Dividends

Boston. Leslie J. Anthony, trading as Dolphin Electric Co., at 6 Dolphin Lane, Boston. First and final dividends of 4s. 4d. in £ payable at 2 New St, Boston, on 17 July.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Bak-Vak. 729,893. Class 9. Vacuum cleaners. New Welbeck Ltd., 120 New Bedford Rd, Luton.

Penguin. 719,729. Class 11. Power-operated refrigerators for domestic use. R. H. Ingham and Co., Ltd, 150 Moore St, Sheffield 3.

Uvisol. 729,709. Class 9. Electro-medical apparatus. Tellux Ltd, 17/19 Edge St, W.8.

Contracts Placed

B.E.A. Three 550,000 lb/hr boilers at Skelton, International Combustion, Ltd., 33 kV main switchgear at Thornhill, A. Reyrolle and Co., Ltd.; One 60,000 kW turbo-generator at Elland, Metropolitan-Vickers Electrical Co., Ltd., Condensing and feed heating plant for one 60,000 kW turbo-generator at same, Vickers-Armstrongs, Ltd., and one 550,000 lb/hr boiler and ancillary equipment also at Elland, Yarrow and Co., Ltd.; Two 30,000 kW turbo-generators at Mexborough, English Electric Co., Ltd.; One 550,000 lb/hr boiler at Stella North, Clarke, Chapman and Co., Ltd.; One 550,000 lb/hr boiler at Stella South, Clarke, Chapman and Co., Ltd.; Ash and dust handling plant at Barony, Babcock and Wilcox, Ltd.; One 60,000 kW turbo-generator, condensing and feed heating plant at Dalmarnock, C. A. Parsons and Co., Ltd., and coal handling plant at same, W. J. Jenkins and Co., Ltd.; Uprating of 132 kV 2,500 MVA switchgear at Barton substation, Metropolitan-Vickers Electrical Co., Ltd.; Two 30 MVA 132/11 kV transformers at Stafford substation, English Electric Co., Ltd.; and 132 kV line from Churchill to Melksham, W. T. Henley's Telegraph Works Co., Ltd.

Birmingham T.C. Installation work in Ley Hill primary school, Harris and Sheldon Ltd.; same at Woodcock Hill primary school, Thomas Glover (Electrical) Ltd.; same at Marsh Hill school, Lee, Beesley and Co., (Birmingham) Ltd.; and at Church Lane School clinic, Midlands Electricity Board.

Southport T.C. Supply and installation of class A lighting along various roads Wardle Engineering Co., Ltd., £10,802.

Stockport T.C. Installation of nine shops at Birmington, Jones, Morris and Co., £924.

BUSINESS PROSPECTS

Home

Birmingham. Cotton, Ballard and Blow have been appointed architects for development of major part of Big Top site as shopping centre. Estimated cost of project by Raventop Developments Ltd., is £5 million.

Bridlington T.C. Application to be made to borrow £15,786 for erection of factory on industrial estate for new company of Ernest Rigg and Son Ltd.

Bristol. P. V. Burnett and Partners of 12 Bloomsbury Sq, London, W.C.1, are architects for premises in Haymarket for Barratts of Northampton.

It is proposed to convert lighting at Shirehampton primary school from gas to electricity. Cost estimated at £2,229.

Croydon. Harrington (London) Ltd., propose to build factory and offices on New Addington estate. Plans by Joseph, 10 Lowndes Sq, S.W.1.

Darlington. T.C. to build shops on Haughton and Nickstream Lane estates.

Doncaster. British Nylon Spinners Ltd., have let contract at about £350,000 for alterations and additions proposed at their Wheatley Hall Rd, premises. Consulting engineers are Scott and Wilson Kirkpatrick and Partners, 47 Victoria St, London S.W.1.

Dudley. Erection of offices etc., being planned by J. Hickman and Son (Brierley Hill) Ltd. Plans by A. Young, 188 High St, Dudley.

Dunstable. Hayward-Tyler and Co., Ltd.'s new factory is likely to cost about £750,000. Architects are Barnes, Challen and Cross, 96 Gloucester Place, W.1.

Grimsby. Factory on Humber Bank site proposed by Courtlands Ltd.

Halesowen T.C. Erection of 28 houses on Howley Grange estate. J. C. T. Cole, Architect, Central Bldgs, Long Lane, Blackheath, nr Birmingham.

Hatfield R.D.C. Application for loan to be made to build 32 houses in Homestead Rd.

Haverfordwest T.C. Plans in hand for erection of 30 dwellings on Jockey Fields estate and further 101 dwellings on City Rd estate.

Kensington. Plans prepared by S. Gordon Jeeves, 61 Catherine Place, S.W.1, for erection in two stages of 176 dwellings in seven blocks in Treverton St area.

Larne T.C. Site at Auterille to be acquired to erect some 500 houses.

London. I. and R. Morley Ltd., are to build five-storey block of offices in Milk St, E.C. Architects are Stanley Peach and Partners, 28 Eccleston Sq, S.W.1.

Middlesbrough. Next year's building programme includes new Prissick Farm No. 1 secondary school and alterations to Acklam Hall and Kirby schools.

Milford Haven (Pemb) U.D.C. It is proposed to erect 46 houses and flats at Gellyswick.

Oxfordshire. Scheme approved for extensions to Burford grammar school estimated to cost £92,000.

Pickering U.D.C. Erection of 16 houses and 4 flats on Westgate site. Council's Architects are Needham, Thorp and White, 6 High Petergate, Yorks.

Portadown (Down). Construction of automatic telephone exchange and inland revenue offices in Carrickblacker Rd. Ministry of Finance (Room 103), Law Courts Building, May St, Belfast.

Salford. First R.C. secondary modern school to be built at Douglas Green Farm. Cost estimated at £160,000. Architects are J. C. Prestwich and Son, Broadshawgate, Leigh.

Scunthorpe T.C. Some 224 houses to be built on Manor Farm estate at cost of about £312,460.

South Shields T.C. Tenders to be invited for erection of 350 houses. Dorset Cafe in Ocean Rd, to be converted into furniture showrooms at cost of £6,000; C. Solomon, 30 St. Mary's Place, Newcastle, is architect.

Tynemouth. £500 to be spent by Newcastle Hospital Board on alterations to electrical mains services at Preston Hospital.

Overseas

Australia. W. E. Ellison of Universal Suppliers Pty., 685 Lutwyche Rd, Lutwyche, Brisbane, wish to represent U.K. firms in clocks, 35 mm projectors, washing machines, electrical goods and other items. Interested persons are advised to write to Mr Ellison, c/o Commercial Bank of Australia Ltd., 12 Old Jewry, London, E.C.2.

Canada. All types of electric pumps, brass and copper fittings, are included in list of items for which Hibbard and Davies Corpn., 3726 Namur St, Montreal, wish to represent U.K. manufacturers.

Colombia. Exclusive agency for 115/125 V and 115/230 V a.c. generators from 1·5 kVA to 12 kVA standard 1,800 r.p.m. sought by Casa Inglesa Ltda., of Apartado Aereo No. 13, Barranquilla, Rep. Colombia. Generators will be coupled to diesel motors of 3½, 5, 7, 8, 10 and 16 h.p. and 625 r.p.m.

France. Installation of ground lighting to be carried out at Montmedy-Marville airfield. Tenders will be sought in due course from N.A.T.O. member countries. Work, valued at £130,000, will include interior electrical installations and ground lighting. Firms should contact Secretariat d'Etat aux Forces Armées "Air," Service de l'Infrastructure, 24 Boulevard Victor, Paris XVéme.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, W.C.2.

A. C. and E. Hughes Ltd. 50 Alexandra Grove, N. Finchley, N.12. Estate and property management, building and decorating, automobile, electrical and mechanical engineers, etc. Nom. cap.: £3,000. Permt. dirs.: A. C. Hughes and J. C. E. Hughes.

Griffin Electronics (Accrington) Ltd. Barnes St, Accrington. Electrical engineers and consultants and contractors, manufacturers of and dealers in television, radio and electrical apparatus, etc. Nom. cap.: £20,000. Dirs.: A. R. Bradshaw, T. Wilson and H. Hoyle.

Barcross Ltd. Bentinck Hse, Bentinck Rd, West Drayton, Middlesex. Heating, lighting, ventilating, air-conditioning, temperature control and fire protection engineers, etc. Nom. cap.: £1,000. Dirs.: R. Shepherd and H. A. Staines.

Cossor Service Ltd. Cossor Hse, Highbury Grove, N.5. Rendering services to owners, dealers, manufacturers, users or others in connection with the installation, repair and maintenance of electrical and electronic devices and apparatus, etc. Nom. cap.: £100. Dirs.: H. Chisholm, J. S. Clark and H. T. Shepherd.

Solartron Electronic Group Ltd. Queen's Rd, Thames Ditton, Surrey. To acquire not less than 90% of shares in Solartron Laboratory Instruments Ltd and Solartron Engineering Ltd, and also not less than 90% of shares of company about to be formed and to be known as Solartron Research and Development, Ltd, electronic engineers, etc. Nom. cap.: £150,000. Dirs.: J. E. Bolton, L. B. Copestick, E. R. T. Ponsford, J. E. Crosse, W. A. Croft and E. E. Jones.

Automation Ltd., Devonshire Hse, Vicarage Cres, S.W.11. Mnfrs. of and dlrs. in automatically operated machines, etc. Nom. cap.: £25,000. Dirs.: to be apptd. by subs. Subs.: G. E. Marbaix and G. E. H. Marbaix.

Brimetrix Ltd. Agents for sale of and dealers in artificial lighting apparatus, electrical plant, machinery, wireless and television sets and accessories, etc. Nom. cap.: £2,000. Dirs.: not named. Subs.: E. R. Watkins, 20 High St, Brimington, Chesterfield; and D. J. Bryant, 47 Ashgate Rd, Chesterfield.

Brooks Ventilation Units Ltd. Manufacturers of and dealers in ventilating and air conditioning equipment, etc. Nom. cap.: £2,000 Dirs.: to be appointed by subs. Subs.: W. Brooks, Woodhatch House, Cockshott Hill, Reigate, Surrey; and N. Carbonero, 83 North End Rd, N.W.11.

Park Wireless Ltd., 35 Ruby St, Manchester, 16. Electric, wireless, electronic and mechanical engineers, etc. Nom. cap.: £15,000. Dirs.: J. P. Cox and Mrs A. Cox.

TRADE NOTES

Sales office. The Anglo-Swiss Screw Co. Ltd. has opened a sales office at 12 St. Ann's Sq, Manchester 2. Telephone: Deansgate 7552. The manager is Mr T. Rogers, M.S.M.A.

Change of Address. The Carlisle Electrical Manufacturing Co. Ltd. have moved to Martin Street, Audenshaw.

Holidays. The works of Transformers (Watford) Ltd. will be closed down for the annual holiday from 23 July to 10 Aug.

Telcon Works, Greenwich, and Farnborough Works, Kent, of the Telegraph Construction and Maintenance Co., Ltd., will shut down from Friday, 16 July, until Tuesday, 3 Aug.

The Enfield works of Belling and Co., Ltd., will be closed from 23 July until 9 Aug.

The Southend-on-Sea works of E. K. Cole Ltd. will be closed for the annual holiday between 17 July and 2 Aug. inclusive.

The Bangor works of Denis Ferranti Meters Ltd. will be closed from 30 July until 16 Aug.

The works of the Hepworth Iron Co., Ltd., will be closed from 9 to 23 Aug.

Architect: C. ST. C. OAKES, M.B.E., F.R.I.B.A., Chief Architect, Boots Pure Drug Co. Ltd.

Boots
THE CHEMISTS

new branch in Plymouth

wired throughout with

Electrical Contractors:
DEVON ELECTRIC & GENERAL SERVICES LTD.
STAVERTON · TOTNES · DEVON

HENLEY CABLES

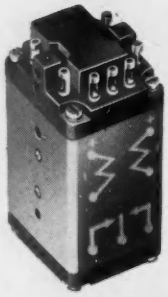
BY APPOINTMENT ELECTRIC CABLE MANUFACTURERS

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD., 51-53, HATTON GARDEN, LONDON, E.C.1.

ELLIOTT

Instruments

FOR ALL APPLICATIONS

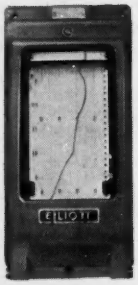


ELLIOTT MOVING COIL MINIATURE RELAY

Highly sensitive, very compact, designed especially for use in low voltage circuits in aircraft, for automatic control and warning systems and wherever minimum space and weight are essential.

ELLIOTT SWITCHBOARD MEASURING INSTRUMENT

Representative of a full range of ammeters and voltmeters available for A.C. and D.C. use. The movements are very accurate and robust with large working forces.

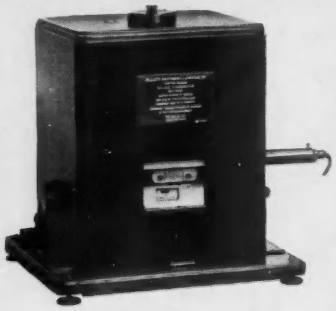


ELLIOTT MINIATURE RECORDER (TYPE 230)

An exceptionally robust, compact and highly sensitive recorder used extensively by the G.P.O. and by electricity undertakings in all parts of the world.

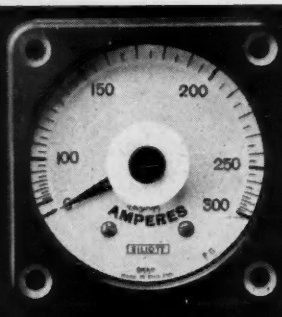
ELLIOTT REFLECTING DYNAMOMETER WATTMETER

A high precision instrument for meter testing and laboratory use, and one of a range which includes A.C. and D.C. voltmeters and ammeters.



ELLIOTT A.C./D.C. COMPARATOR (Shotter-Hawkes)

The most accurate commercial means available for precise measurement of Amps, Volts and Watts at power frequencies.



ELLIOTT LONG SCALE SWITCHBOARD INSTRUMENT

One of the new Elliott range of small, compact instruments designed to take up minimum panel space. 3½" dial, 6½" 240° scale.

ELLIOTT BROTHERS (LONDON) LTD. provide a complete instrumentation service for Industry. Wherever there is a demand for accurate measurement, recording or control, experienced Engineers choose ELLIOTT equipment. Shown above is a selection of ELLIOTT instruments. The wide range now available enables every requirement to be met from a single source. Full details on request.

ELLIOTT BROTHERS (LONDON) LTD., CENTURY WORKS, LONDON, S.E.13 (TIDeway 3232)

CLASSIFIED ADVERTISEMENTS

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 32s. 6d. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

TENDERS INVITED

CITY OF PETERBOROUGH

THE Council invites tenders from recognised electrical contractors for the electric lighting and power installations to 80 (10 blocks of 8) Single Bedroom and Single Person's Flats, on the Dogsthorpe North Estate, Peterborough.

Drawing, Specification and Form of Tender may be obtained on application to Mr F. J. Smith, M.B.E., A.M.I.C.E., City Engineer and Surveyor, Town Hall, Peterborough.

Applications, before noon on Saturday, 24 July, 1954, should be accompanied by a cheque for £2. 2s. made payable to the Peterborough City Council. This will be returned on receipt of a bona fide tender or the return of the documents.

C. PETER CLARKE,
Town Clerk.

Town Hall,
Peterborough.
July, 1954. (K 471)

METROPOLITAN BOROUGH OF WANDSWORTH
REPAIR OF TIME SWITCHES

TENDERS are invited for the repair of approximately 700 synchronous solar dial electric time switches.

Tender form, etc., obtainable from the Borough Engineer, must be returned to me by noon, Wednesday, 25 Aug., 1954.

R. H. JERMAN,
Town Clerk.

Municipal Buildings,
Wandsworth, S.W.18. (K 484)

BOROUGH OF PWLLHELI
PROPOSED NEW LIGHTING SCHEME
TOWN HALL

TENDERS are invited by the Pwllheli Corporation from experienced Electrical Engineers for a scheme of lighting for the Auditorium of the Town Hall, Pwllheli. Starting date 4 Oct., 1954, and all work to be completed by 25 Oct., 1954.

Plans and further particulars to be obtained from the Borough Surveyor, Pwllheli, and all Tenders to be delivered in sealed envelopes marked "Lighting Scheme" to the undersigned, not later than 7 Aug., 1954.

CYRIL C. DAVIES,
Town Clerk.

Municipal Offices,
Pwllheli.
2 July, 1954. (K 388)

SOUTHAMPTON C.B.C.

INVITES TENDERS from Electrical Contractors for Harefield Junior and Infants' School—Electrical Installation, to be Sub-Contract with Main Contractor (R.I.B.A. Contract plus Supplemental Conditions available for inspection). Forms and particulars from Borough Architect on £5 deposit by 19 July, 1954, refunded on receipt of bona fide Tender not subsequently withdrawn, or return of documents. Tenders to the Borough Architect, Civic Centre, Southampton, by 10 a.m. on 5 Aug. 1954. (K 451)

CITY OF MANCHESTER

THE Education Committee invites tenders for the Electrical Installation required at Poundswick County Grammar School, Wythenshawe, Manchester: specification and tender form may be obtained from the City Architect, Town Hall. Deposit £1. 1s. (returnable). Tenders, sealed in endorsed envelopes, must be delivered before 10 a.m. on 16 Aug., 1954.

PHILIP B. DINGLE,
Town Clerk.

12 July, 1954. (K 489)

APPOINTMENTS VACANT

Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18–64, or a woman aged 18–59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

BRITISH ELECTRICITY AUTHORITY
Headquarters

REQUIRE a PRINCIPAL ASSISTANT ENGINEER in the Civil Engineering Branch of the Generation (Station Construction) Sub-Department with wide experience in heavy Civil Engineering design and construction, some knowledge of building and a full knowledge of contract procedure, including field experience of major contracts. Experience in modern Power Station construction would be an advantage and preference will be given to those who are Corporate Members of the Inst.C.E.

The successful candidate will be responsible for supervising the activities of a number of Engineers engaged in the critical examination of projects for building and civil engineering works associated with Power station construction and will also be responsible for dealing with such other aspects of the work as may be delegated to him.

Salary provisionally within N.J.M. Scale 4, £1,650/£1,800 inclusive.

Applications stating age, qualifications, experience, present position and salary to D. Moffat, Director of Establishments, Winsley St, London, W.1, by 3 Aug., 1954. Quote Ref. E.T./495. (K 448)

STAFFORDSHIRE COUNTY COUNCIL
Education Committee

APPLICATIONS are invited for ELECTRICAL ENGINEERING ASSISTANTS within the salary Grade A.P.T. I to IV (£490/£625 per annum).

Applicants should have passed Part I of the I.E.E. Associate Membership Examination or hold equivalent qualifications.

Form of application and further particulars can be obtained from:

County Education Architect,
Green Hall, Lichfield Rd,
Stafford,

and should be returned within 10 days of this advertisement.

T. H. EVANS,
Clerk of the County Council.
(K 423)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

Shropshire and Herefordshire Sub-Area Headquarters

SECOND ASSISTANT ENGINEER
(CONSTRUCTION AND MAINTENANCE)

Applicants should have experience in the design, construction and maintenance of E.H.T. outdoor substations and transmission and distribution systems. Technical qualifications desirable. Salary £787/£818 per annum (N.J.B. Grade "G" 6).

ENGINEERING DRAUGHTSMAN

Applicants should be capable of assisting in the design and layouts of outdoor switching sites and small and medium substation buildings. Salary £433/£567 per annum (N.J.B. Schedule "D" Grade 6).

Apply, in writing, within 14 days, stating age, experience, present salary and position to Mr W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gardens, Ditherington, Shrewsbury.

Central Gloucestershire Sub-Area

GENERAL ASSISTANT DISTRICT ENGINEER
(STROUD DISTRICT)

Experience necessary in all branches of Distribution Work including operation and maintenance of high and low voltage cables and overhead lines, substations, etc. Technical qualifications desirable. Salary £555/£569 per annum (N.J.B. Grade E.10).

DEMONSTRATOR (FEMALE)
(DEAN FOREST DISTRICT)

Applicants must have had a good education and should hold a certificate of a recognised Domestic Training College and/or the E.A.W. certificate. Duties include lecture demonstrations in Service Centres and on consumers' premises and advice to consumers on the selection and use of electrical apparatus. Salary £400/£490 per annum (N.J.C. Grade 1).

Apply, in writing, within 14 days stating age, experience, present salary and position to Mr D. Holt, Sub-Area Manager, Midlands Electricity Board, 126 London Rd, Gloucester.

A. STEPHENS,
Secretary.
(K 468)

POWER STATION ELECTRICAL AND MECHANICAL ENGINEER

required for service with the SUDAN LIGHT AND POWER CO., LTD., in Khartoum, Sudan, as Deputy Power Station Superintendent. Basic salary on appointment within the range £E.1,500/£E.2,000 per annum according to qualifications and experience (£E.1=£1. 0s. 6d.). Candidates should be between the age of 30 and 45 years, and have had not less than 10 years experience in the construction and operation of modern power stations equipped with boilers and turbine alternator sets operating at not less than 400 p.s.i.g. and 750° F, and E.H.T. switchgear and associated control equipment. Experience with oil fired boilers, and also diesel alternators up to 1,200 kW of value. Evidence should be produced of having held positions of responsibility requiring organising and administrative ability. Initially duties will include the supervision of erection and commissioning of a steam power station equipped with two 5 MW steam turbine alternator sets.

Appointment will be on contract by arrangement up to 10 years, including a period of 12 months probation, with a bonus payable on completion of the contractual period. Free living accommodation with basic furniture or an allowance in lieu thereof will be provided. After satisfactory completion of the probationary period liberal leave on full salary with free passages. In addition to basic salary a cost of living allowance will be payable; and a kit allowance of £E.50 on appointment.

Applications stating age, education, qualifications, experience (with particulars of posts held), present appointment and salary with names of two references should be submitted to the Secretary, The Power and Traction Finance Company Limited, Queens House, Kingsway, London, W.C.2. (K 454)

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments:

Fens Sub-Area

93/54.R.

THIRD ASSISTANT ENGINEER
(OPERATION AND MAINTENANCE)

The Sub-Area is operating as one administrative unit and the operational base for this appointment will be at St. Neots.

Candidates should have had experience in the operation and maintenance of overhead and underground systems, dealing with faults, system loadings, etc. Possession of the Higher National Certificate in Electrical Engineering, or its equivalent, will be an advantage.

Salary in accordance with Class H, Grade 11 of the National Joint Board Salary Agreement commencing at £607.

Apply to the Manager, Fens Sub-Area, Eastern Electricity Board, Milton Hall, Milton, Cambridge.

Essex Sub-Area

South-West Essex District
95/54.R.

TWO GENERAL ASSISTANT ENGINEERS

Candidates should have had a sound training in electrical engineering and experience in the construction, operation and maintenance of H.V. and L.V. underground and overhead distribution systems.

Salary in accordance with Class G, Grade 11 of the National Joint Board Salary Agreement commencing at £573, plus London Weighting.

Apply to the District Manager, South West Essex, Eastern Electricity Board, 1 Havana Close, South St, Romford, Essex.

Northmet Sub-Area Headquarters

Southgate, London, N.14
81/54.N.

THIRD ASSISTANT ENGINEER
(PLANNING AND DEVELOPMENT)

Candidates should have had experience in the planning and construction of large urban and rural high voltage and low voltage distribution systems (including substations) at voltages up to 33 kV. Corporate membership of the Institution of Electrical Engineers or the possession of a degree in electrical engineering will be an advantage.

Salary in accordance with Class N, Grade 10 of the National Joint Board Salary Agreement commencing at £846, plus London Weighting.

Apply to the Manager, Northmet Sub-Area, Eastern Electricity Board, Northmet House, Southgate, London, N.14.

Future salary and conditions of service for all these appointments will be in accordance with agreements made from time to time by the appropriate negotiating bodies.

The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Applications, by letter stating age, education, qualifications and experience, with details of present appointment and salary, should be submitted to the Manager concerned within fourteen days of the appearance of this advertisement. (K 466)

THE EAST AFRICAN POWER AND LIGHTING CO. LTD.

require for service in Kenya, a TECHNICIAN experienced in the installation and maintenance of Power Line carrier current equipment. The successful applicant will be expected to work also on electronic voltage regulators, communication systems and power system protective circuits, etc., but he need not necessarily have had previous experience of these provided he is willing to learn.

Salary £720 p.a. plus marriage allowance £100 p.a. (if applicable).

Cost of living allowance up to approximately £90 p.a. Free housing or allowance of 20% of basic salary in lieu. Free medical attention and electricity and contributory Pension Scheme.

Apply to the East African Power and Lighting Co., Ltd., 66 Queen St, London, E.C.4. (K 364)

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT DISTRICT ENGINEER
Dorking and Epsom District

SALARY £587 p.a. under N.J.B. Agreement, Class "E," Grade 9. Superannuable. Applicants should be suitably qualified and have had training and experience in construction, operation and maintenance of underground and overhead distribution systems up to 11 kV. The position will entail standby duties.

Applications on forms from W. B. Hayden, M.I.E.E., District Manager, SEEBoard, 56 South St, Dorking, naming 2 referees, by 28 July, 1954.

GENERAL ASSISTANT ENGINEER
Guildford District

Salary £524 under N.J.B. Class E, Grade 11. Superannuable. Applicants should be suitably qualified and have had training and experience in the construction, operation and maintenance of underground and overhead distribution systems.

Applications on forms from W. E. Affleck, M.I.E.E., M.INST.F., Guildford Manager, SEEBoard, 99 High St, Guildford, Surrey, naming 2 referees, by 28 July, 1954.

A. L. BURNELL,
Secretary.

July, 1954. (K 461)

BRITISH ELECTRICITY AUTHORITY
East Midlands Division

APPLICATIONS are invited from suitably qualified engineers for the following positions:

ASSISTANT SHIFT CHARGE ENGINEERS
DRAKELOW POWER STATION
Vacancy No. 102/54/E.T.

Applicants must have technical qualifications up to H.N.C. standard and have received a sound engineering training followed by operating experience with large capacity High Pressure Plant, preferably in conjunction with P.F. Boilers.

Salary for this appointment will be within Class J, Grade 9 (£719/£750 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 26 July, 1954.

ASSISTANT ENGINEER
(COAL AND ASH PLANT)
DRAKELOW POWER STATION
Vacancy No. 103/54/E.T.

Applicants must have wide experience of operation and maintenance at a large Power Station employing P.F. Boiler Plant.

Candidates should have suitable technical qualifications admitting to Corporate Membership of the Institution of Mechanical Engineers and/or the Institution of Electrical Engineers.

The successful applicant will be responsible to the Station Superintendent for the programming of coal traffic and for the operation of the coal and ash plants.

Salary for this appointment will be within Class J, Grade 8 (£764/£796 per annum), of the National Joint Board Agreement.

Closing date for receipt of applications, 26 July, 1954.

DRAUGHTSMEN,
TRANSMISSION DEPARTMENT,
DIVISIONAL HEADQUARTERS
Vacancy No. 105/54/E.T.

Draughtsmen are required in the Transmission Department at this Divisional Headquarters. Experience on the design and construction of H.V. substations or overhead transmission lines an advantage.

Salary, according to experience and ability, within Grade 6 (£433/£567 per annum) or Grade 5 (£567/£671 per annum) of Schedule D of the National Joint Board Agreement.

Closing date for receipt of applications, 26 July, 1954.

The above positions will be pensionable within the provisions of the British Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the official form which may be obtained from the Divisional Establishments Officer, British Electricity Authority, P.O. Box 25, Barker Gate, Nottingham, and should be returned by the date stated. Please quote Vacancy Number.

L. J. JEFFREY,
Divisional Controller.
(K 460)

A CAREER AS A REGULAR ARMY OFFICER FOR QUALIFIED ENGINEERS

MECHANICAL, ELECTRICAL AND ELECTRONIC ENGINEERS are required as officers in the Corps of Royal Electrical and Mechanical Engineers.

There are two methods of entry. These are either:

(1) On a short service commission (which offers a good opportunity of obtaining a permanent commission) with a gratuity of about £100 for each completed year of service on leaving, or
(2) On a Permanent Regular Commission with a valuable pension and a terminal grant of £1,000 (tax free).

Candidates must be physically fit and not yet 29 years old, and have passed or be exempt from examinations of either the Institution of Mechanical Engineers or the Institution of Electrical Engineers as required for graduates, or have a University degree in Natural Science or Engineering. In addition 2½ years' experience as an engineer (or 1½ years in the case of University graduates) is normally required.

The pay which Army officers may expect is according to the following table:

Rank	*Normal Age*	*If Single*	*If Married*
Lieutenant	23	£686	£831
Lieutenant	25	£723	£860
Captain	27	£860	£997
Major	34	£1,188	£1,325
Lt. Colonel	42	£1,453	£1,581
Colonel	45	£1,791	£1,919
Brigadier	49	£2,065	£2,184

(Note.—This is the U.K. scale; there are various additions in certain overseas stations. In this table the figures of a single officer's pay include an element for food and accommodation which are normally provided in kind. This has been done to provide a direct means of comparison with civilian scales of pay.)

For further details please write to:
The War Office (AG1 (Officers) C), London, S.W.1, and quote this publication. (K 450)

SOUTH EAST SCOTLAND ELECTRICITY BOARD

JUNIOR ENGINEER (N.J.B., Class G, Grade 16). Initially for Galashiels. Applicants should be young engineers qualified to Higher National standard who wish to gain further experience in rural and urban distribution work.

Applications stating age, experience, present position and salary, and giving two referees should reach the Manager, Southern Sub-Area, South East Scotland Electricity Board, High St, Galashiels, by Tuesday, 27 July, 1954. (K 440)

BRITISH ELECTRICITY AUTHORITY
Eastern Division

APPLICATIONS are invited for the following posts:

(a) STATION SHIFT CONTROL/BOILER SHIFT CONTROL ENGINEER, PETERBOROUGH GENERATING STATION
(b) STATION SHIFT CONTROL ENGINEER NORWICH GENERATING STATION

Salaries Class F, Grade 10, £577/£598 per annum.

Applicants should have reached the standard of Ordinary National Certificate in Electrical Engineering, or its equivalent, have experience in the operation of a Switchboard at a Generating Station and be fully conversant with High Voltage Switching operation and protective systems. Applicants for appointment (a) should in addition have had experience in the operation of a pulverised fuel fired steam raising plant.

The applicant appointed at Peterborough will be required to interchange the duties of Station Shift Control Engineer and Boiler Shift Control Engineer.

Applications stating age, details of experience and qualifications should be sent to the Controller, British Electricity Authority, Eastern Division, Northmet House, Southgate, N.14, to arrive not later than 24 July, 1954.

W. N. C. CLINCH,
Controller.
(K 458)

PROFESSIONAL ENGINEERS IN VARIOUS GOVERNMENT DEPARTMENTS

THE Civil Service Commissioners invite applications for pensionable posts in a wide variety of mechanical and electrical engineering duties. Provisionally the latest date for applications is 31 Dec., 1954, but an earlier date may be announced and early application is advised.

Candidates must be under 35 on 1 Jan., 1954, with extension for regular service in H.M. Forces and up to two years for permanent civil service. For the Post Office they must be at least 21, for the Ministry of Supply and Ministry of Transport and Civil Aviation at least 23, and for all other Departments at least 25 on that date.

Generally a candidate must possess a University degree in Engineering or be a Corporate Member of one of the professional institutions—Mechanical Engineers, Electrical Engineers, or Civil Engineers or have passes in, or exemption from Sections A and B of the corresponding Associate Membership examinations. Exceptionally candidates of high professional attainment, but without the specified qualifications, may be admitted. For some posts Associate Fellowship of the Royal Aeronautical Society or an Honours degree in Physics or Engineering will be accepted.

London salary scale (men) £650 (at age 25) to £1,000. Starting salary according to age up to £900 at 34. Candidates entering below age 25 will start at salaries varying from £450 at age 21 to £570 at age 24. Prospects of promotion. Salaries of next higher grades are £1,000—£1,320 and £1,375—£1,575. Somewhat lower for women and in the provinces.

Further particulars and application forms from Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting No. S85/54.

(K 419)

SOUTHERN ELECTRICITY BOARD

ASSISTANT ENGINEER (PLANNING)

ALDERSHOT District of No. 3 (Portsmouth) Sub-Area. Salary N.J.B. Class F, Grade 9, Column 1 (£607 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist the Planning Engineer in the preparation of schemes and estimates for extensions of and reinforcement to overhead and underground H.V. and L.V. networks, and will be required to undertake standby duties if required. The possession of suitable technical qualifications will be an advantage.

The successful applicant will be required to contribute to the B.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton Lane, Cosham, Portsmouth, and returned to him not later than 30 July, 1954. (K 465)

SOUTH WEST SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for the post of THIRD ASSISTANT ENGINEER (Planning and Development) (2 appointments in the Chief Engineer's Department. Applicants should have had works experience of manufacture and design of distribution plant and preferably have had some experience of the design, construction and operation of a 33 kV distribution system. A specialised knowledge of some branch of distribution engineering would be an advantage. Salary N.J.B. Schedule "C," AX/DX £649/£858 per annum.

The posts are superannuable. Applicants should possess a degree or equivalent qualification in Electrical Engineering and be Corporate Members of the Institution of Electrical Engineers.

Forms of application may be obtained from the applicants' appropriate officer or the undersigned, and should be returned to the undersigned not later than Saturday, 24 July, 1954.

J. MEEK,
Secretary.

62 Dalziel Drive,
Glasgow, S.1.
5 July, 1954. (K 435)

YORKSHIRE ELECTRICITY BOARD

No. 7 (Grimsby) Sub-Area

THIRD ASSISTANT ENGINEER (CONSTRUCTION)

APPLICANTS must hold at least the Higher National Certificate in Electrical Engineering and should preferably be Graduates of the Institution of Electrical Engineers. They should have experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Salary: N.J.B. Class H. Grade 10, £641/£667 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Rd, Grimsby, not later than 29 July, 1954.

No. 5 (Wakefield) Sub-Area

Barnsley District

THIRD ASSISTANT DISTRICT ENGINEER
(2 posts)

Applicants must have had a sound practical training and considerable experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Applicants must hold a current driving licence, be prepared to reside in the district and undertake standby duties.

Preference will be given to those who are Corporate Members of the Institution of Electrical Engineers or who hold equivalent qualifications.

Salary: N.J.B. Class F, Grade 9, £607/£629 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a, Denby Dale Rd, Wakefield, not later than 29 July, 1954.

No. 2 (Huddersfield) Sub-Area

Huddersfield District

ASSISTANT CONSUMERS' ENGINEER

Applicants must have had sound practical training and some experience in the work of a Consumers Engineer. The successful candidate will be required to give advice to all classes of consumer concerning the utilisation of Electricity. Experience in the interpretation of the I.E.E. Wiring Regulations and in Tariffs will be an advantage. Preference will be given to applicants holding the Higher National Certificate in Electrical Engineering.

Salary: N.J.B. Class H, Grade 12, £565/£586 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 2 (Huddersfield) Sub-Area, Yorkshire Electricity Board, Market Street, Huddersfield, not later than 29 July, 1954. (K 452)

MIDLANDS ELECTRICITY BOARD

DISTRICT MANAGERS
KIDDERMINSTER AND BANBURY

APPLICATIONS are invited for appointments as Manager at the Kidderminster and Banbury districts of the Worcester and District Sub-Area.

Applicants should have sound experience in general supervision and management, in the engineering associated with the development and maintenance of electricity distribution systems, and in commercial development and electrical contracting work. Technical qualifications desirable.

The salaries payable will be:

Kidderminster—N.J.M. Scale II, £1,300/£1,450 per annum.

Banbury—N.J.M. Scale I, £1,150/£1,300 per annum.

Applications, giving details of age, experience, qualifications and present position and salary should be forwarded within 7 days to Mr R. Mallet, Manager, Worcester and District Sub-Area, Whittington, Worcester.

A. STEPHENS,
Secretary.
(K 467)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments, which are superannuable and subject to medical examination:

(1) SECTION ENGINEER in the Runcorn District. Salary £649/£681 p.a. (N.J.B. Class E, Grade 7).

(2) ASSISTANT SECTION ENGINEER in the St. Helens District. Salary £607/£629 p.a. (N.J.B. Class F, Grade 9).

Applicants for posts (1) and (2) should have experience in H.T. and L.T. overhead and underground distribution work, and preferably have the technical qualifications to enable them to become Chartered Electrical Engineers. The successful applicants may be required to undertake standby duties.

Application forms obtainable from the Manager, No. 2 Sub-Area, Sandiway Hse, near Northwich, Cheshire. Closing date: 26 July, 1954.

(3) SECOND ASSISTANT ENGINEER (Planning and Development) in the No. 3 Sub-Area Headquarters at Chester. Salary £817/£852 p.a. (N.J.B. Class J, Grade 7).

Applicants for post (3) should have experience in all aspects of the distribution of electricity, knowledge of the technical and economic principles underlying the design of distribution networks, and the technical qualifications necessary to enable them to become Chartered Electrical Engineers.

Application forms obtainable by written request from the Manager, No. 3 Sub-Area, Electricity Hse, Newgate St, Chester. Closing date: 26 July, 1954. (K 441)

BRITISH ELECTRICITY AUTHORITY

South Wales Division
Divisional Headquarters

APPLICATIONS are invited for the following superannuable N.J.B. appointments:

Vacancy No. 70/54

GENERAL ASSISTANT ENGINEER
GENERATION (OPERATION) DEPARTMENT

Salary AX/CX 6, 7 or 8 (£501/£765 per annum).

Knowledge of the control of inter-connected power systems, operation and maintenance of power station plant.

LLYNFI POWER STATION

Vacancy No. 71/54

ASSISTANT ENGINEER
(COMBUSTION AND EFFICIENCY)

Salary G.7 (£729/£758 per annum).

Preferably have obtained H.N.C. and served a regular apprenticeship. Previous experience with large pulverised fuel boilers and Bailey Automatic Combustion Control desirable.

Application forms obtainable from Secretary, South Wales Division, British Electricity Authority, Twyn-y-Fedwen Rd, Gabalfa, Cardiff, to be returned by 26 July, 1954.

(K 478)

THE NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the appointment of GENERAL ASSISTANT ENGINEER, Chief Engineer's Department, Construction Section, Carliol Hse, Newcastle-upon-Tyne.

Applicants should possess Higher National Certificate or equivalent qualification, must have a thorough knowledge of high voltage and low voltage overhead lines and be familiar with B.S. 1320 construction. Experience in the survey and erection of 66 kV Steel tower lines an advantage. Duties will entail surveying, profiling and issuing of all constructional details for overhead lines.

The successful candidate will normally be stationed at Newcastle-upon-Tyne, but must be prepared to work for periods in any of the Board's five Sub-Areas. Salary—Schedule "C," Grade 8, £501/£694 per annum. N.J.B. conditions of service.

Applications stating age, qualifications and experience should be forwarded to the Secretary (Establishments), North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle-upon-Tyne, within ten days of the appearance of this advertisement.

(K 449)

BRITISH ELECTRICITY AUTHORITY
Midlands Division

APPLICATIONS are invited for the following positions in the Generation (Operation) Department. N.J.B. service conditions, superannuable appointments, salaries within Schedule "A" of the Agreement:

(*a*) SHIFT CHARGE ENGINEER at Stafford Power Station, Grade B7, commencing at £559 per annum (Vacancy No. 709 MD).

(*b*) JUNIOR ENGINEER at Walsall Power Station, Grades G16 to 14 commencing at £402 per annum (Vacancy No. 710MD).

Applicants for these positions should have received a sound technical training, and for (*a*) a knowledge of the operation and maintenance of steam generating plant and main switchgear. Qualified marine engineers with electrical experience would be considered suitable. Appropriate qualifications an advantage.

Apply, quoting the vacancy number on form A.E.6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 31 July, 1954. (K 470)

BRITISH ELECTRICITY AUTHORITY
South Western Division

STATION CHEMIST required at Hayle Generating Station.

Superannuation Scheme. Salary, N.J.B. Class "F" Grade 7. £697/£718.

Candidates should possess H.N.C. in Chemistry or equivalent and have experience in the testing and analysis of fuels, oils and the control of boiler water conditions.

Applications on Form A.E.6/ACT, obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol, 8, should be completed and returned by 26 July, 1954. (K 455)

NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF JUNIOR ENGINEERS, SUB-AREA MAINS ENGINEER'S DEPARTMENT, MANCHESTER

APPLICANTS should possess the H.N.C. in Electrical Engineering or an equivalent qualification and should have had a basic works training of not less than two years.

Successful candidates will be required to work in Manchester and surrounding districts, and will be given the opportunity to gain experience in various sections of the Mains Engineer's Department.

Salary Scale: £402/£547 p.a. Grades M 21/17, N.J.B. Conditions.

Applications to Sub-Area Secretary, No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, by 24 July, 1954.

APPOINTMENT OF SECOND ASSISTANT ENGINEER (PLANNING AND CONSTRUCTION), SUB-AREA MAINS ENGINEER'S DEPARTMENT, PRESTON

Applicants should have wide experience in the design, survey and construction of overhead and underground transmission and distribution systems with associated substations, operating at pressures up to 33 kV.

Preference given to applicants who are Corporate Members of the Institution of Electrical Engineers or hold equivalent qualifications.

Salary Scale: £926/£966 p.a. Grade L7, N.J.B. Conditions.

Applications to Sub-Area Manager, No. 4 Sub-Area, The North Western Electricity Board, 40/41 Lune St, Preston, by 24 July, 1954. (K 426)

BRITISH ELECTRICITY AUTHORITY
South Eastern Division

JUNIOR ENGINEER (Chemist)—Littlebrook Power Station. Applicants should have Matriculated and be studying for Inter. B.Sc. or Higher National Certificate. N.J.B. conditions of service, Class M Grades 21/17 commencing at £427 p.a. including London allowance. Applications giving details of education, present position, experience, etc., should be sent to the Station Superintendent, Littlebrook Power Station, nr. Dartford, Kent, by 22 July. (K 459)

BRITISH ELECTRICITY AUTHORITY
London Division

APPLICATIONS are invited for the following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A. Salary includes London Allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. for posts (a) and Corporate Membership for post (b) an advantage.

(a) ASSISTANT ENGINEER (INSTRUMENTS)—BATTERSEA GENERATING STATION
Vacancy No. 54/556

Sound technical background with considerable experience in maintenance of all types of Instruments required. Knowledge of Electronic Instruments an advantage. Candidates will be expected to have a sufficient administrative experience to run a small department. Salary: Class M, Grade 11=£783. 16s. p.a.

(a) INSTRUMENT ENGINEER — BRUNSWICK WHARF GENERATING STATION
Vacancy No. 54/557

Duties will cover maintenance, calibration and repair of Boiler House and Turbine House instruments for steam and water flows, remote boiler control gear and general instruments. Salary: Class K, Grade 12=£662 11s. p.a.

(b) DEPUTY STATION SUPERINTENDENT—STEPNEY GENERATING STATION
Vacancy No. 54/558

Candidates should have received a sound technical and practical training and have experience in the operation and maintenance of generating plant, cost and efficiency. A knowledge of the Agreements covering personnel necessary with a successful record in labour relations. Salary: Class F, Grade 3 =£957. 12s. p.a.

(a) STATION SHIFT CONTROL ENGINEER—WEST HAM GENERATING STATION
Vacancy No. 54/559

Candidates should have sound technical training and practical experience in the control and operation of steam generating plant and main switchgear in modern generating station. Salary: Class H, Grade 10= £673. 1s. p.a.

(a) JUNIOR ENGINEERS
Vacancy No. 54/560

Junior Engineers required at various power stations in the London Area. Excellent opportunities for training and promotion to higher grades. Salary and conditions of service in accordance with N.J.B. Agreement.

Applications, quoting vacancy number, may be made on form obtainable from Divisional Secretary, British Electricity Authority, London Division, Generation House, Great Portland St, W.1, and be received within 14 days of this advertisement. (K 457)

THE SOUTH WALES ELECTRICITY BOARD

require ENGINEERING DRAUGHTSMAN in the Central Sub-Area at Cardiff.

Salary: Schedule D (£433/£567) of N.J.B. Agreement.

Applications stating age, present position and salary qualifications, experience, and three referees, to be addressed to the Secretary to arrive by 24 July, 1954.

D. G. DODDS,
Secretary.

St. Mellons,
Cardiff. (K 453)

BRITISH ELECTRICITY AUTHORITY
Midlands Division

ASSISTANT SHIFT CHARGE ENGINEER is required at Walsall Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule A, Grade G9, commencing at £641 per annum.

A sound technical training and power station experience in the operation and maintenance of steam generating plant and main switchgear required. Appropriate qualifications an advantage.

Apply, quoting Vacancy No. 707MD on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 31 July, 1954. (K 462)

BRITISH ELECTRICITY AUTHORITY
South West Scotland Division

ASSISTANT SHIFT CHARGE ENGINEER CLYDE'S MILL

APPLICATIONS are invited for the position of Assistant Shift Charge Engineer at Clyde's Mill Power Station, Cambuslang.

The post will be superannuable and the salary in accordance with Class "J," Grade 9 of the National Joint Board Agreement will be at the commencing rate of £719 per year. Applicants should have attained the Higher National Certificate in electrical or mechanical engineering and have had power station control room experience.

Applications on Forms AE 6 which may be obtained from the Divisional Office of the Authority, should be forwarded to the Divisional Secretary, 168 Broomhill Drive, Glasgow, W.1, before Tuesday, 27 July, 1954. (K 464)

BRITISH ELECTRICITY AUTHORITY
Midlands Division

GENERAL ASSISTANT ENGINEER is required in the Telecommunications Section of the Technical Department. N.J.B. service conditions, superannuable appointment, salary within Schedule C, Grade 8, commencing in range £501/£639, ultimately rising to £694 per annum.

Experience in the manufacture, design, commissioning and maintenance of various types of supervisory apparatus and communication equipment as applied to power undertakings is required. Suitable technical qualifications an advantage.

Apply, quoting Vacancy No. 706MD on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 31 July 1954. (K 463)

LONDON ELECTRICITY BOARD

ENGINEER (OPERATION AND MAINTENANCE)

APPLICATIONS are invited for the above position in the Walthamstow District of the North Eastern Sub-Area.

Applicants should possess good technical qualifications and have had experience in system operation, high voltage and low voltage mains work and in the maintenance of substation and transformer chambers.

The post is graded under Schedule "A" of the National Joint Board agreement as Class F, Grade 9—£637. 7s. per annum rising to £660. 9s. per annum inclusive of London Allowance.

Application forms obtainable from Personnel Officer, 46/7 New Broad St, E.C.2, to be returned completed within ten days of the publication of this advertisement. Please enclose addressed envelope and quote ref: V/1768/T on all correspondence. (K 424)

BRITISH ELECTRICITY AUTHORITY
North West, Merseyside and N. Wales Division

VACANCY No. 120/54 — STATION SHIFT CONTROL ENGINEER, Rawtenstall Generating Station. Salary £502/521. (C.10).

Vacancy No. 122/54—ASSISTANT SHIFT CHARGE ENGINEER, Stuart St Generating Station. Salary £680/£706. (H 9).

Applications in writing to Controller, British Electricity House, 825 Wilmslow Rd, Manchester 20, before 24 July. Quote Vacancy No. (K 456)

BRITISH ELECTRICITY AUTHORITY
Headquarters, Bankside, London

REQUIRE DRAUGHTSMEN for work on either:

(a) Civil and Building Works in connection with outdoor Grid Substations, or

(b) Electrical Layouts and Diagrams for Grid Substations.

Salary N.J.B. Grade 6, Schedule "D," £458/£595 (inclusive) according to qualifications and experience. Pension scheme. One Saturday morning in four on duty. Forms from D. Moffat, Director of Establishments, Winsley St, London, W.1. Quote Ref. AE/491. (K 447)

BRITISH ELECTRICITY AUTHORITY
Yorkshire Division

REQUIRE a GENERAL ASSISTANT ENGINEER (Electrical), in the Generation Construction Department at Rotherham.

Salary £501/£714 per annum, Class AX/EX, Grade 8, National Joint Board Agreement.

Applicants should have had a sound practical training and should hold the Higher National Certificate in Electrical Engineering, or equivalent. Drawing office experience of layouts and diagrams, or site experience, with either switchgear, motor control gear, cables, lighting and heating installations would be an advantage.

Application forms A.E.6/ACT, obtainable from the Divisional Secretary, (Establishments), British Electricity House, St. Mary's Rd, Leeds 7, to be returned within 14 days of the appearance of this advertisement.

G. A. VOWLES,
Divisional Controller.
(K 469)

MIDLAND ELECTRIC MANUFACTURING CO. LTD.
Invite applications for the position of
ADVERTISING AND PUBLICITY MANAGER

THE position involves responsibility for press advertising, catalogues, brochures and publicity material in general.

Applicants should preferably be under 40 years of age and have good organising ability with sound experience in the preparation and production of the foregoing matter, with ability to co-ordinate work with the Company's Advertising Agents.

The appointment is permanent, with excellent prospects, offering scope for personal initiative. A pension scheme is applicable.

Write giving fullest particulars of education, previous experience and salary required to: Sales Director, Midland Electric Manufacturing Co., Ltd., Reddings Lane, Tyseley, Birmingham 11. (K 427)

BRITISH ELECTRICITY AUTHORITY
South West Scotland Division
ENGINEER—BARONY POWER STATION

THE British Electricity Authority, Generation Construction Department has a vacancy for a Resident Engineer in connection with the construction of Barony Power Station, Ayrshire. Applicants should preferably be Corporate Members of an appropriate Professional Institution and have some steam power station experience. The salary payable, within the range £649/£970, will be in accordance with the ability and experience of the candidate. Compulsory superannuation scheme. Residence near the site is essential and it is hoped that a house will be available.

Applications on form A.E.6 which may be obtained from the Authority's Headquarters or from any Divisional Office of the Authority should be forwarded to the Divisional Secretary, British Electricity Authority, 168 Broomhill Drive, Glasgow, W.1, before 28 July, 1954. (K 434)

FOR AUSTRALIA
CABLE INSTALLATION ENGINEERS

ASSISTANT ENGINEERS required for cable installation work for permanent service in Australia with large Cable Manufacturing and Contracting Company. Salary according to qualifications and experience. Applicants will receive a period of training in the United Kingdom before appointment confirmed. Apply stating age, qualifications and experience to:
Box No. 3657, Electrical Times. (K 344)

A WELL-KNOWN electrical company has a vacancy for a senior SALES ENGINEER based on their London office. The successful applicant must be a trained electrical engineer with Ordinary National Certificate as a minimum qualification and with previous experience in the London or South Eastern counties area. The post carries a responsibility for the organisation and control of three sales engineers. A generous salary is offered together with non-contributory pension scheme.—Box No. 3677, Electrical Times. (K 480)

IMPERIAL CHEMICAL INDUSTRIES LIMITED
Alkali Division
Northwich, Cheshire

has a vacancy for an Electrical Engineer for work on design and later on the maintenance of generating plants and distribution networks. Candidates, age 25-35, should possess a good degree in Electrical Engineering and have had sound workshop experience. Starting salary according to age and experience. Applications giving details of age and experience should be addressed to the Staff Manager, Imperial Chemical Industries Ltd., Alkali Division, P.O. Box No. 7, Northwich, Cheshire. (K 380p)

AN opportunity occurs in progressive manufacturing concern in London area for ENGINEER aged 25/35 with electrical or physicist degree, on development and research work on high frequency telecommunication cable and associated testing equipment. Salary will be commensurate with qualifications and experience. Apply giving full particulars to—Box No. 3641, Electrical Times. (K 321)

ASSISTANT GENERAL MANAGER, good remuneration, pension scheme and prospects. Apply Chairman, Cables and Plastics Ltd., c/o 7 Bond Place, Leeds, 1. (K 445)

ASSISTANT ELECTRICAL ENGINEER, required for service on a Tin Mine in Malaya, preferably aged 25 to 30, single, to have completed apprenticeship and to have minimum technical qualification—Ordinary National Certificate—and have had subsequent experience in installation, operation and maintenance of H.T. and L.T. Plant.

First Contract for three years, renewal by mutual agreement. Starting salary from ST.$500/$550/- plus cost of living allowance at present ST.$200/- per month. Pension Schemes.

Free furnished quarters, Medical attention, Passage and Leave pay. Apply Box No. 1144, c/o Abbott Ltd. 32 Eastcheap, London, E.C.3. (K 422)

ALKALINE BATTERIES LTD., of Redditch, are the largest makers in the Empire of Alkaline accumulators, miners' lamps and emergency lighting systems, which are in rapidly growing use particularly for export. The company has vacancies in its Technical Sales and Development Sections for Graduate ELECTRICAL ENGINEERS, not over 30 years of age, or for men nearing the end of their Degree Course who have completed National Service. The posts are pensionable and offer the prospect of executive rank. Applications with full educational details and experience should be addressed to Commercial Manager, Alkaline Batteries Ltd., Union St, Redditch. (K 23)

ELECTRICAL ENGINEER, aged 23/28, with leanings towards commercial work, required by well-known porcelain insulator manufacturers in the Midlands. The successful applicant would receive training in H.T. Insulator Design Department and would be considered for subsequent transfer to Technical Sales. Starting salary £450/£750 p.a. according to age and qualifications. Apply—Box No. 3687, Electrical Times. (K 487)

ELECTRICAL DRAUGHTSMAN required by firm of Consulting Engineers for work on lighting and power installations for all classes of building. Applicants should have practical experience and should be capable of preparing specifications under supervision. Qualifications O.N.C. minimum.

Write stating qualifications, experience, age, and salary required, to J. Roger Preston and Partners, 15 North Audley St, London, W.1. (K 474)

DRAUGHTSMEN AND DESIGNERS, preferably with experience of mechanism or sheet metal work or electrical switchgear or control gear. Modern factory; good conditions; A.E.S.D. rates or above, according to experience and qualifications. Apply in writing to Mr Thomson, the Belmos Co., Ltd., Industrial Estate, Blantyre, Lanarkshire. (K 365)

ELECTRICAL ENGINEER qualified, required by cable manufacturers, to work on the design of cable fittings. The work involves the development of fittings for polythene insulated high voltage cables. Practical experience of cable accessories desirable. This post is pensionable and carries a salary of £550/£600 upwards according to qualifications and experience. Write details quoting reference RG/2 to: Staff Officer, The Telegraph Construction and Maintenance Co., Ltd., Telcon Works, Greenwich, S.E.10. (K 473)

CONSULTING Engineers require ASSISTANT MECHANICAL ENGINEER for London office. Should have at least graduate membership of the Institution of Mechanical Engineers and some experience of thermal power station design and construction. Salary according to qualifications but not less than £720 per annum. Applications with full details of qualifications and experience to Preece, Cardew and Rider, 12 Queen Anne's Gate, Westminster, London, S.W.1. (K 472)

ELECTRICAL DRAUGHTSMEN required in London for the design and layout of power and lighting installations and distribution systems, including preparation of estimates, etc.; H.N.C. qualification.

Write stating age, qualification, experience and present salary to—Box No. 7818, c/o Charles Barker and Sons Ltd., 31 Budge Row, London, E.C.4. (K 437)

ELECTRICAL DRAUGHTSMAN required for design of work's sub-stations, H.T. and L.T. distribution systems, lighting layouts, etc. Apply, giving full details of age, training, experience and technical qualifications to The Lancashire Steel Corporation Ltd, Irlam Works, Irlam, Manchester. (K 421)

ELECTRICAL AND MECHANICAL DRAUGHTSMAN wanted for manufacturing Electrical Engineers, West London District, state age, experience and salary.—Box No. 3669, Electrical Times. (K 416)

THE ENGLISH ELECTRIC CO., LTD.

Appointments are available with The English Electric Co., Ltd., on important work covering Application Engineering on all classes of electrical equipment. These appointments are pensionable after a qualifying period and apprentice-trained men with Higher National Certificate in Electrical or Mechanical Engineering or equivalent, and with previous experience on Application work are preferred.

Experience in the manufacturing or power supply industries or in the application or installation of electrical equipment in any branch of industry or engineering is an alternative qualification and professional engineers in these fields are also invited to apply.

A number of vacancies also exist for apprentice-trained engineers seeking an opportunity of acquiring Application Engineering experience. Reply stating age, experience, qualifications and quoting Ref. S.A.33C to Dept. C.P.S., 336/7 Strand, W.C.2. (K436p)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2.

RESEARCH AND DEVELOPMENT

The J. Stone Group of Companies, which has extensive and expanding interests in electrical and mechanical engineering, offers Permanent Positions on its Research and Development Staff to:

(a) DESIGN AND LABORATORY ASSISTANTS for development of light electrical and mechanical equipment, with prospects of advancement later to technical or sales staff overseas. Previous design experience not essential, but applicants should be of degree standard, and have had works experience.

(b) SENIOR DRAUGHTSMEN dealing with light mechanical and electrical equipment, especially dynamo-electrical machinery, automatic control gear, and mechanical drives. Works experience essential. O.N.C. or H.N.C. preferred.

Applications in first instance giving full details training, etc., to:

Personnel Manager,
J. Stone and Co. (Deptford) Ltd.,
Arklow Road, London, S.E.14.

(K 385p)

FIRST-CLASS ELECTRICIAN. Tradesman with wide experience plant maintenance. Good rate and prospects. Free pension. Unique canteen facilities. Write Personnel Manager, the Shredded Wheat Co., Ltd., Welwyn Garden City. (K 429)

INDUSTRIAL, Electrical and Mechanical Repair Specialists require a young ENGINEER REPRESENTATIVE for the London District. Applications in confidence to: London Sales Manager, Dowding and Mills Ltd., 26 White Post Lane, London, E.9. (K 413)

POWER CABLE PLUMBER JOINTERS required for short-term contracts. Possibility of continued employment in U.K. on completion of overseas contract.—Box No. 3671, Electrical Times. (K 431)

SIMPLEX ELECTRIC CO., LTD.
Water Heating Department
APPOINTMENT OF SALES MANAGER

Applications are invited for the position of Sales Manager, Water Heating Department, which is located at the Blythe Bridge Factory, near Stoke-on-Trent. Applicants who should be between the ages of 30 and 45 must have had considerable experience in the electric water heating field, preferably in an executive capacity. Applications in writing, giving full details of experience, qualifications and salary required, should be addressed to the Secretary, Simplex Electric Co., Ltd., Oldbury, Birmingham. (K443p)

IMPERIAL CHEMICAL INDUSTRIES LTD., Plastics Division has an immediate vacancy for an ELECTRICAL DRAUGHTSMAN in the Chief Engineer's Department at Welwyn Garden City. Candidates must have served a recognised apprenticeship and should hold the Ordinary National Certificate. Experience of factory and general industrial installation work would be useful.

An attractive starting salary will be offered to the selected applicant beyond which there is plenty of scope for progression to a good salary ceiling at a relatively early age. The appointment is permanent and carries membership of the Staff Pension Fund.

Apply giving full particulars to the Staff Manager, I.C.I. Ltd., Plastics Division, Black Fan Rd, Welwyn Garden City, Herts. (K 430)

LINESMEN-ERECTORS for steel tower overhead transmission lines required. 3s. 11½d. per hour for fully experienced men. 7s. per day out allowance. Only men with previous experience of this work need apply to Labour Officer, 30 Leicester Sq, London, W.C.2, marking envelope "Linesmen-Erector." (K 428)

LAYOUT DRAUGHTSMEN required by Consulting Engineers for electrical layout work including H.V. and L.V. outdoor substations, indoor switchgear and cable diagrams.

Applicants should possess or should be studying for H.N.C. or equivalent. Salary in accordance with qualifications. Apply in writing reference KJB/RFS to Messrs Kennedy and Donkin, 12 Caxton St, Westminster, London, S.W.1. (K 378)

MURGATROYD'S SALT AND CHEMICAL CO., LTD., require an ELECTRICAL DRAUGHTSMAN at their Elworth Works, Sandbach, Cheshire. Applicants should have a good knowledge of H.T. and L.T. substation design, rectifier and D.C. installations, the preparation of schematic diagrams, power and lighting layouts. Experience in heavy chemical industry is desirable. Salary in accordance with experience and qualifications. The successful applicant will be required to join the Company's superannuation scheme and will receive help with housing accommodation if required. Applications, with full details of experience, to be addressed to "Technical Manager." (K 442)

OUTSIDE SALES ENGINEER required by company manufacturing electrical rotation machinery one to 100 h.p. The successful applicant will be based at Loughborough, Leics, and will have to cover the East Midlands area. Possession of Ordinary National Certificate in Electrical Engineering is a necessary qualification and previous experience of this range of products is essential. Salary dependent upon qualifications and experience. Non-contributory superannuation scheme.—Box No. 3675, Electrical Times. (K 479)

PLASTIC Cable Makers invite applications for positions of SALES MANAGER AND WORKS MANAGER. Reply giving experience, etc., to—Box No. 3673, Electrical Times. (K 446)

REPRESENTATIVES with established connections required to promote new and first-class electrical domestic equipment. Car owners essential. Must be able and willing to work hard. Full support given. Write full particulars to: Napper, Stinton, Woolley Ltd. (BPD), 14-19 Gt. Chapel St, London, W.1. (K 417)

REPRESENTATIVE required by well-known Domestic Appliance Manufacturers to cover the Midlands and North including Manchester, Leeds, etc. Wide experience of the Wholesale Trade, Electricity Boards and Local Authorities essential. Remuneration by Salary, Commission and Expenses. Must be car owner. Position offers vast scope to successful applicant. Present Staff notified.—Box No. 3679, Electrical Times. (K 481)

DESIGN ENGINEER

An EXCEPTIONAL OPPORTUNITY exists in SOUTH EAST LONDON for a DESIGN ENGINEER with sound theoretical knowledge and recent industrial experience in the design of A.C. and D.C. machines, and low voltage control gear. This appointment offers rapid advancement to a position of superior technical and administrative responsibility. The salary will be commensurate with the requirements.

Applications giving full details of training and experience should be sent to:

Box 2 V G 7249, A.K. Advg.,
212a Shaftesbury Ave, London, W.C.2.

(K 384p)

SHIFT CONTROL ENGINEER required by the Steel Company of Wales Limited (Steel Division), at their Margam Power Plant.

Applicants should possess evidence of advanced technical training and have knowledge of the operational control of H.T. interconnected network, together with some experience in turbine and boiler operation.

Higher National Certificate or equivalent desirable.

Salary £775 per annum according to qualifications and experience.

Those wishing to apply should write for official Application Form to the Personnel Superintendent, The Steel Company of Wales Limited, P.O. Box No. 3, Port Talbot. (K 476)

SALESMAN required for Electrical Department. Please write giving full details of experience to the Secretary, Heal and Son, 196 Tottenham Court Rd, W.1. (K 483)

SALES ENGINEERS, D.C. and A.C. Motors and Control Gear, required London, Manchester, and Birmingham areas. Outside sales experience essential. Apply—Box No. 3681, Electrical Times. (K 482)

THE GENERAL ELECTRIC CO., LTD., invites applications from YOUNG MEN not older than 30 years of age, who are interested in the commercial application of electric heat to industry. Vacancies exist in the Process Heating Department at the Head Office of the Sales Organisation for those with experience in this type of work and with a minimum technical standard of Ordinary National Certificate in Electrical Engineering. There are excellent prospects for promotion. Apply in writing, quoting reference P.H. to The Staff Manager, Magnet House, Kingsway, London, W.C.2. (K 477)

ELECTRICAL RESEARCH AND TESTING ENGINEERS

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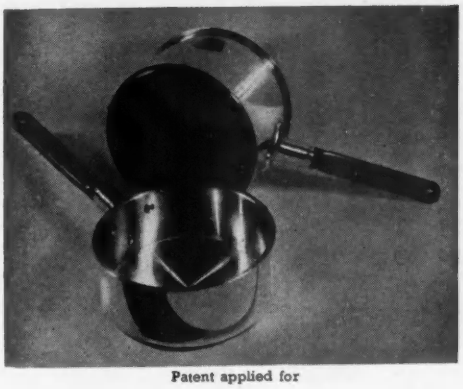

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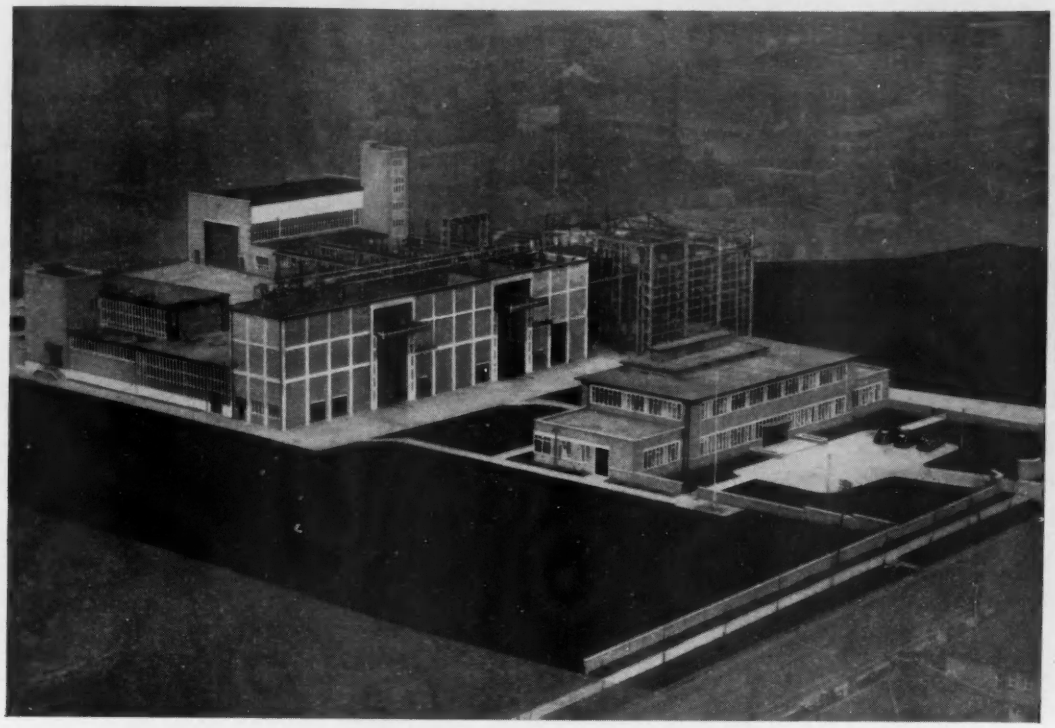

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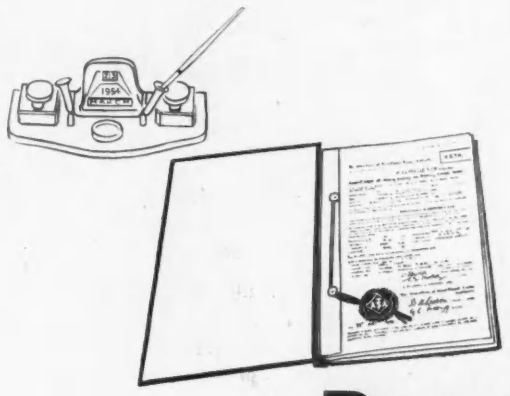

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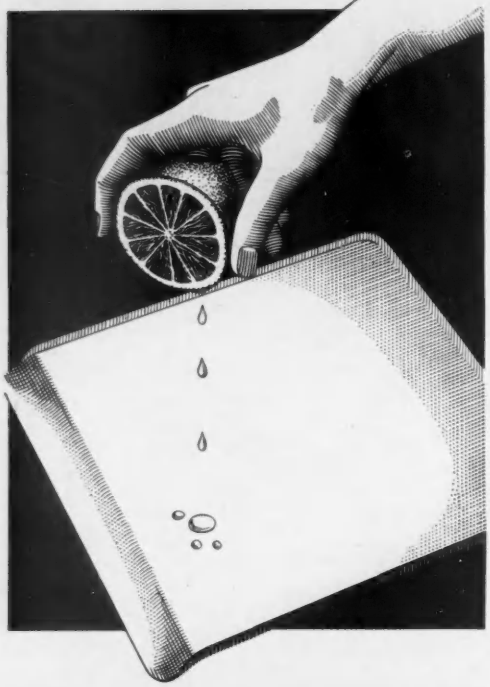

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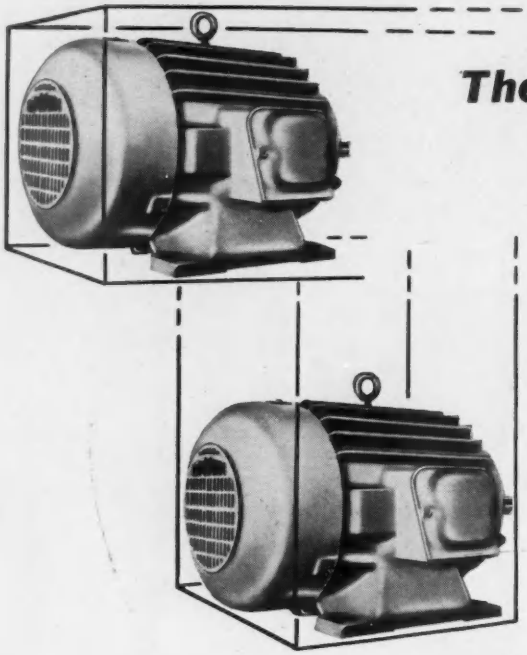

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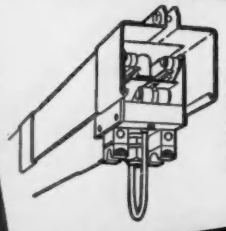

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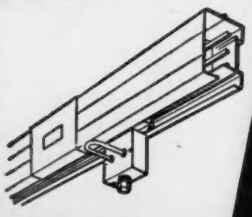

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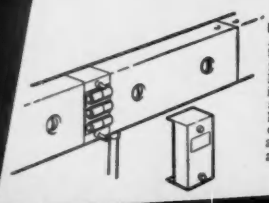

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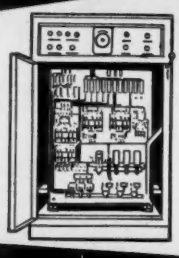

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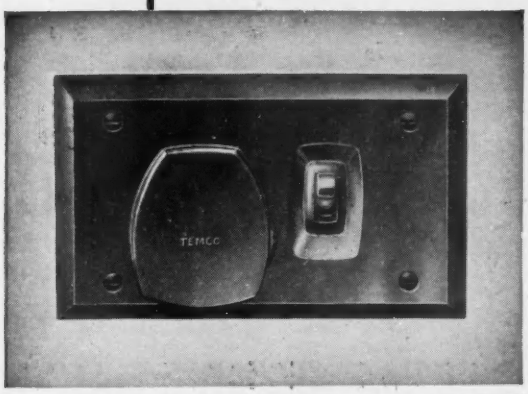

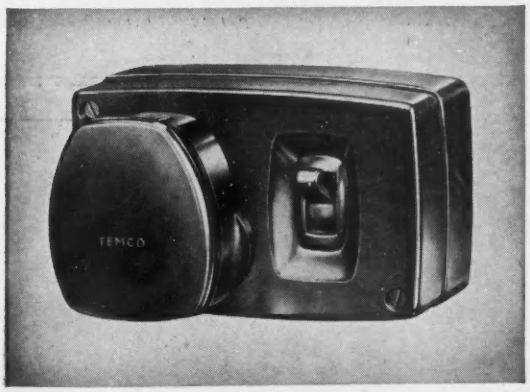

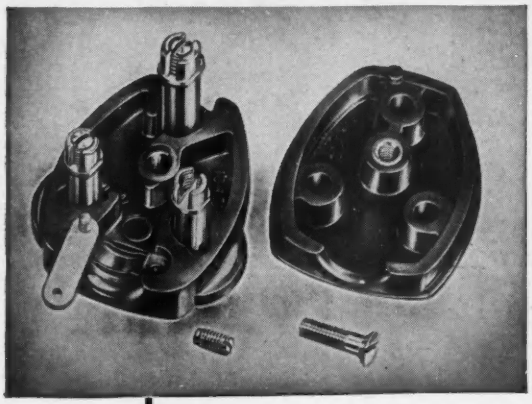

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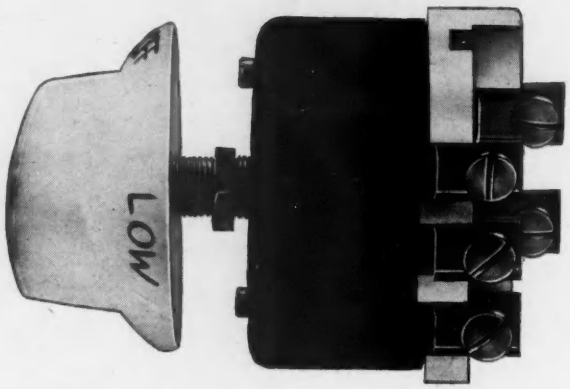

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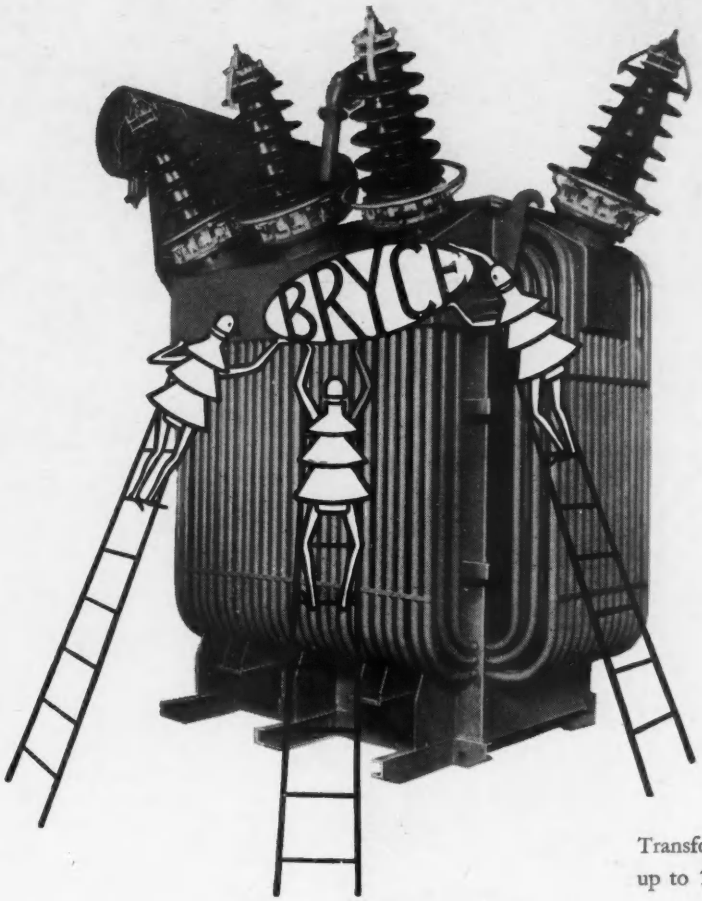

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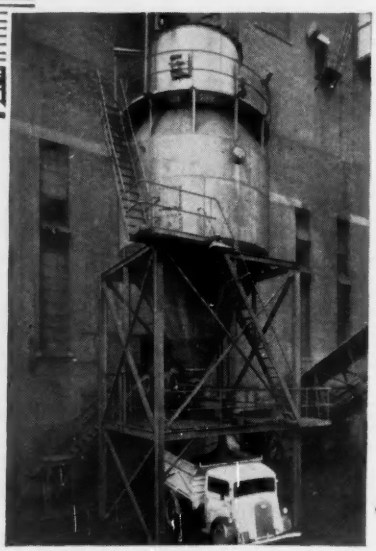

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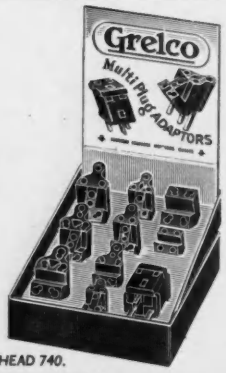

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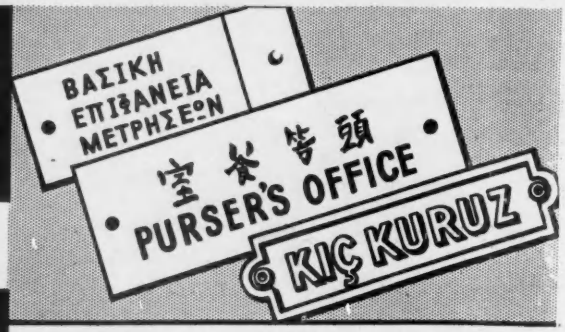

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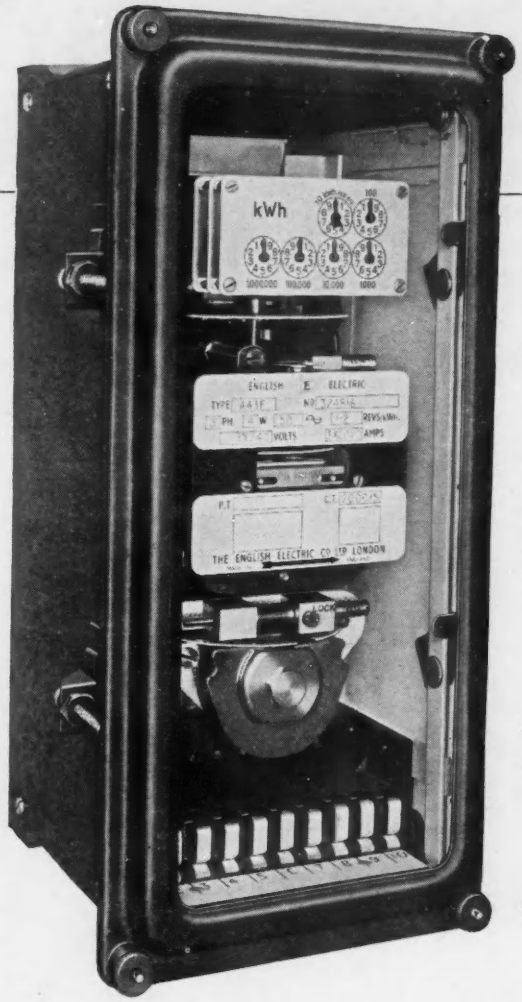
for

switchboard mounting



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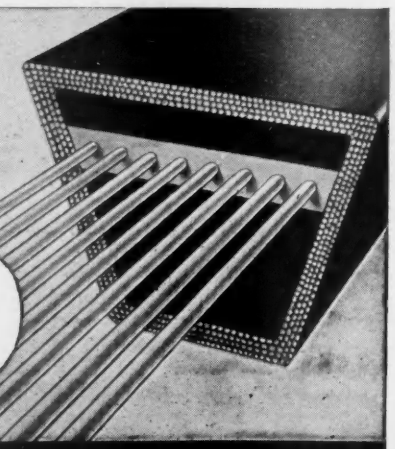

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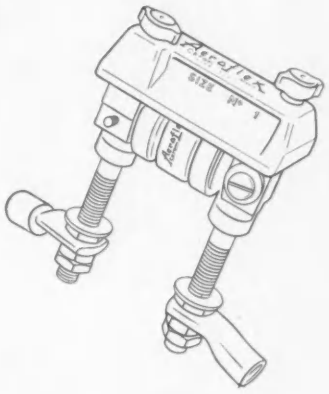

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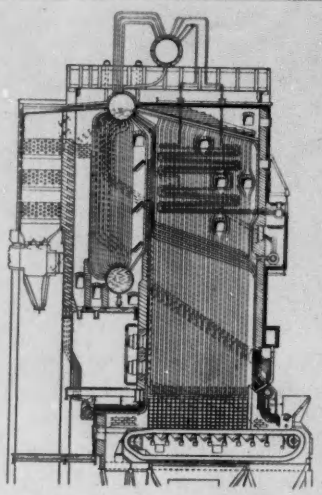

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